THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXXXII. No. 2092.] LONDON, JUNE 16, 1903. [55TH YEAR. PRICE 6d.

PARKER & LESTER,

— ESTABLISHED 1830 —

MANUFACTURERS AND CONTRACTORS, **ORMSIDE STREET, LONDON, S.E.**

THE ONLY MAKERS OF

PATENT ANTIMONY PAINT & PARKER'S IMPERIAL BLACK VARNISH.

OXIDE PAINTS, OILS, AND GENERAL STORES, FOR GAS AND WATER WORKS.

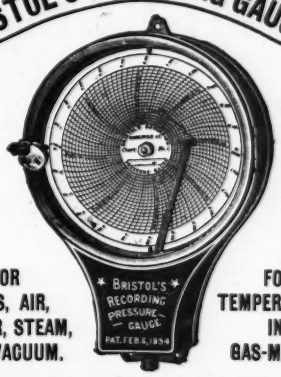
SAFETY GAS-MAIN STOPPER,

FOR SHUTTING OFF GAS IN MAINS TEMPORARILY DURING ALTERATIONS AND REPAIRS.

GAS-LEAK INDICATOR.

PRICES AND PARTICULARS ON APPLICATION.

BRISTOL'S RECORDING GAUGES



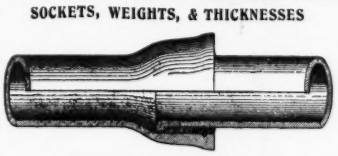
FOR GAS, AIR, WATER, STEAM, OR VACUUM.

FOR TEMPERATURE IN GAS-MAINS.

Many Thousands in Daily Operation.

J. W. & C. J. PHILLIPS,
23, COLLEGE HILL,
LONDON, E.C.

SOCKETS, WEIGHTS, & THICKNESSES



TO ENGINEER'S SPECIFICATION.

VERTICALLY CAST IRON PIPES.

Diameters 1½ in. to 78 in.

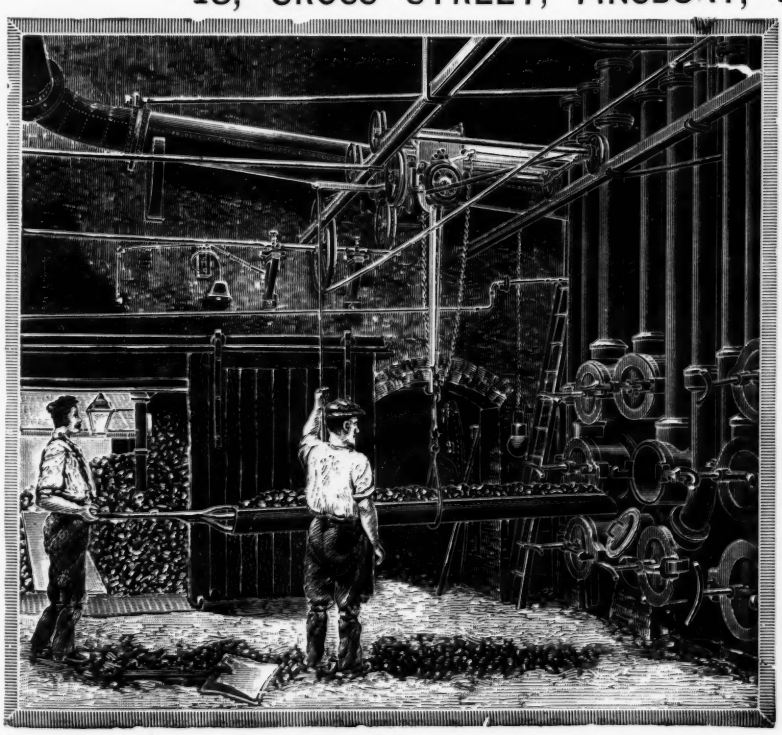
The Best Pipes on the Market and the Cheapest.

A. G. CLOAKE, 54, Holborn Viaduct, London, E.C.

Telegrams: "AMOUR, LONDON." Telephone Nos.: 1890 HOLBORN; CENTRAL 194.

BIGGS, WALL, & CO.,

13, CROSS STREET, FINSBURY, LONDON, E.C.



Telegrams: "RAGOUT, LONDON."
Telephone: 273 CENTRAL.

"RAPID"
MANUAL & POWER
CHARGING APPARATUS,

FOR GAS-WORKS OF ALL SIZES.

Repeat Orders
YEOVIL, NEWPORT, SOUTHBANK, WORTHING, ALDERSHOT.

Machines can be seen working at any of the following Works:—

ALDERSHOT	WREXHAM
WORTHING	SWINDON
YEOVIL	EPSOM
TRURO	SHETTLESTON
NORMANTON	DUBLIN
OTLEY	G. S. & W. Rly. Works
GOOLE	NEWPORT, MON.

ALBION IRON WORKS,
MILES PLATTING,

MANCHESTER.
TELEGRAMS—
"STOKER,
MANCHESTER."

WEST'S GAS IMPROVEMENT CO., LD.,

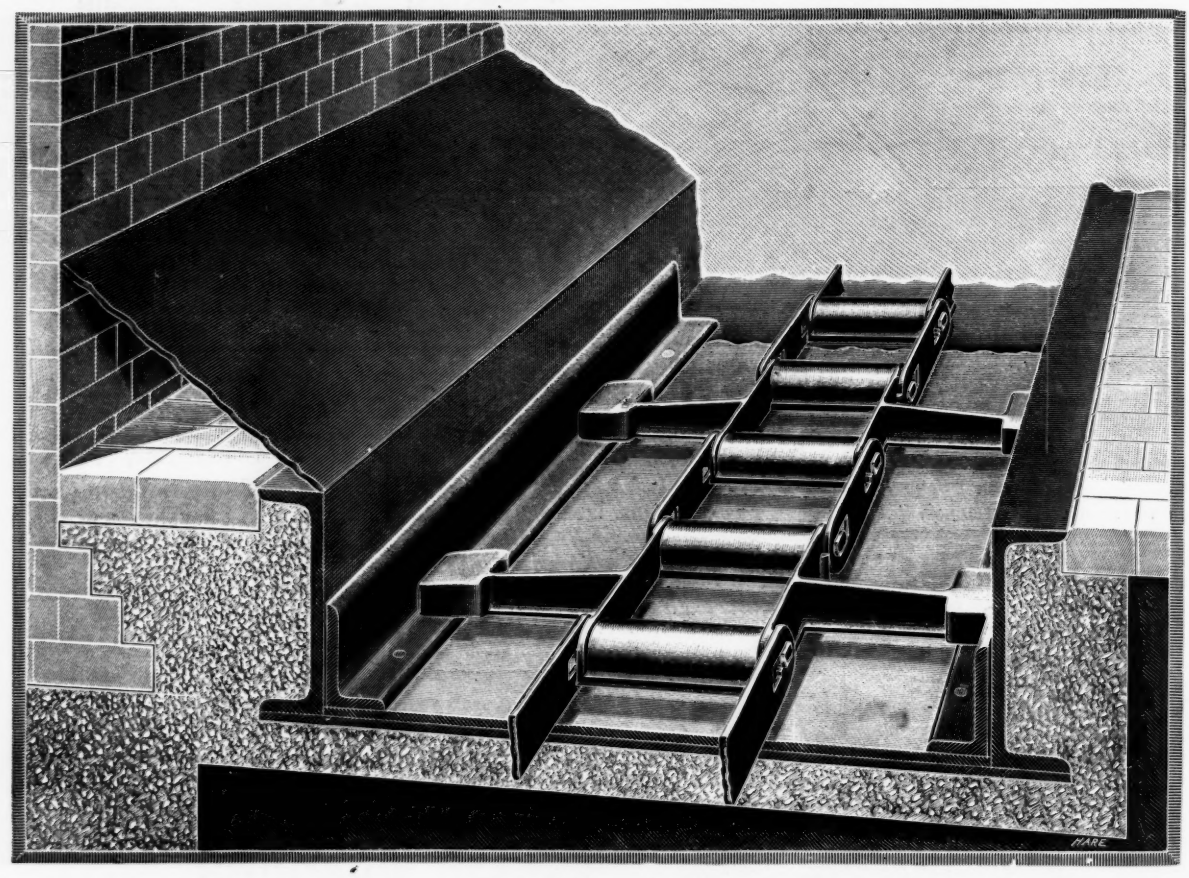
Gas and General Engineers.

CONTRACTORS FOR

COMPLETE RETORT-HOUSE PLANT

. . EITHER ON . . .

THE HORIZONTAL OR INCLINED SYSTEMS.



SECTION OF

WEST'S IMPROVED PATENT HOT-COKE CONVEYOR,

With Special Chain constructed with a minimum number of parts, and having Large Joint Pins with ample Bearing Surfaces.

WEST'S STOKING MACHINERY— COMPRESSED AIR DRIVEN AND MANUAL SYSTEMS.

COAL BREAKING, ELEVATING, & STORING PLANTS.

BELTON'S PATENT AUTOMATIC RELIEF APPARATUS FOR HYDRAULIC MAINS.

Manufacturers for America: Riter-Conley Manufacturing Company, Pittsburg.

THE BARROWFIELD IRON-WORKS, LIMITED,

Late LAIDLAW, SONS, & CAINE, Limited,

GAS ENGINEERS & CONTRACTORS

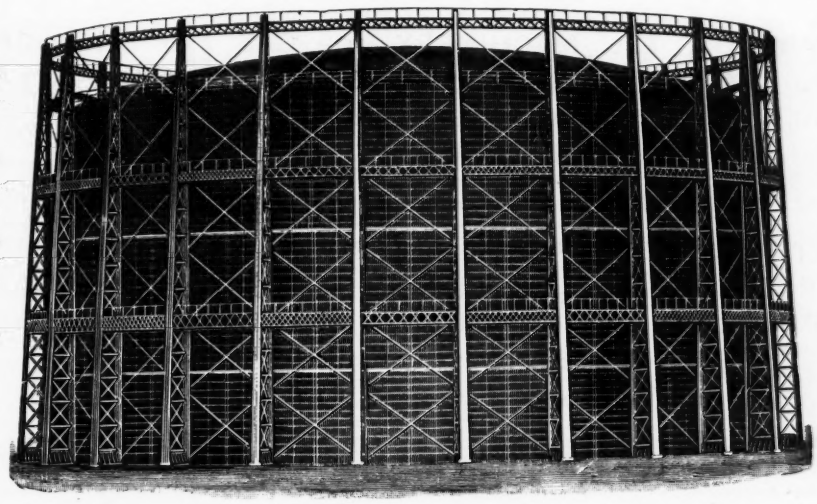
Telegrams: "GASOMETER GLASGOW." GLASGOW.

OIL PLANT AND CHEMICAL APPARATUS.

BRIDGES, GIRDERS WHARVES, PIERS.

ROOFING OF EVERY STYLE.

PIPES, VALVES AND CONNECTIONS.



GAS APPARATUS OF EVERY DESCRIPTION.

RETORTS, CONDENSERS, SCRUBBERS, PURIFIERS.

GASHOLDERS. AND TANKS.

ENGINES, EXHAUSTERS, STEAM BOILERS AND FITTINGS.

THREE-LIFT GASHOLDER. Capacity, SIX MILLION cubic feet.
240 feet Diameter by 45 feet Deep each Lift. Erected at Glasgow, 1893.

London Office: 6, LITTLE BUSH LANE, CANNON STREET.

R. LAIDLAW & SON, LIMITED.

ENGINEERS & IRONFOUNDERS,

CAST-IRON PIPES

ALL SIZES.

MANUFACTURERS OF

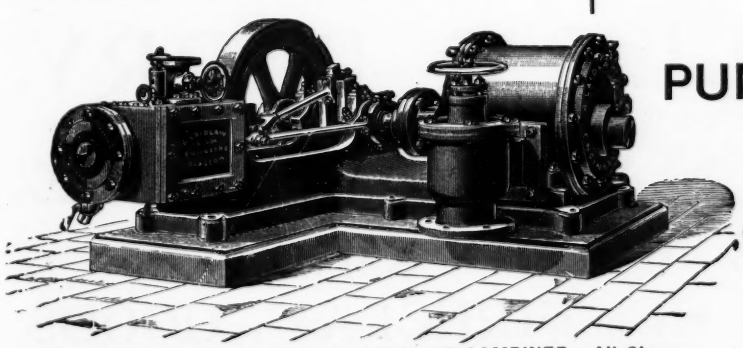
STEAM-ENGINES,

EXHAUSTERS,

VALVES,

AND

PUMPING-ENGINES.



BEALE'S GAS EXHAUSTERS AND ENGINE COMBINED. All Sizes.

ALL KINDS OF

GAS AND WATER APPARATUS.

ALLIANCE FOUNDRY, GLASGOW. | SIMON SQUARE WORKS, EDINBURGH. | 6, LITTLE BUSH LANE, LONDON, E.C.

NEWTON, CHAMBERS, & CO.,

LIMITED,

THORNCLIFFE IRON-WORKS, NEAR SHEFFIELD.

Established 1790

LONDON OFFICE: **19, Great George Street, WESTMINSTER.**

Telegraphic Addresses: "NEWTON, SHEFFIELD," "ACCOLADE, LONDON."

GAS ENGINEERS IRONFOUNDERS & CONTRACTORS.

MANUFACTURERS OF EVERY DESCRIPTION OF

PLANT, APPARATUS, AND MACHINERY FOR GAS AND CHEMICAL WORKS, RETORTS AND FITTINGS, MOUTHPIECES WITH SELF-SEALING LIDS. IMPROVED COAL AND COKE HANDLING PLANT, CONVEYORS AND ELEVATORS, CONDENSERS, SCRUBBERS AND WASHERS.

PURIFIERS with Planed Joints a Speciality.

PATENT CENTRE-VALVES, RACK AND SCREW VALVES, WOOD GRIDS, AND SCRUBBER-BOARDS, CAST-IRON MAINS, AND SPECIALS.

STRUCTURAL WORK, COLUMNS, GIRDERS, AND ROOFING.

GASHOLDERS CAST-IRON OR STEEL TANKS.

DESIGNS, SPECIFICATIONS, and ESTIMATES FREE.

PIG IRON (SPECIAL QUALITY) for Engine Cylinders. GAS COAL famous for its unrivalled excellence.

BARRY, HENRY, & CO.,

— *LIMITED.* —

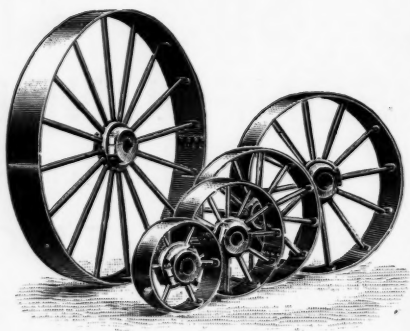
Specialities:

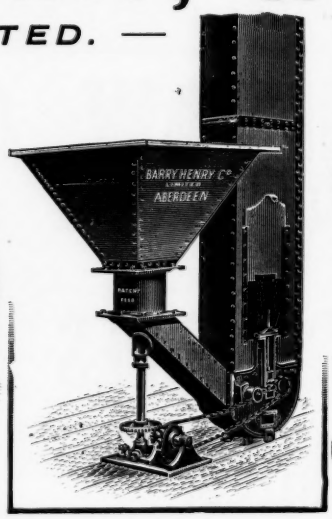
TRANSMISSION OF POWER.

Rope & Belt Pulleys,
Spur & Bevel Wheels,
Shafting & Couplings,
Pedestals. & Fixings.

WORKS:

ABERDEEN
SCOTLAND.





Specialities

TRANSMISSION OF MATERIALS.

Conveyors
Elevators,
Grinding Machinery,
Motors.

AND

64, MARK LANE,
LONDON, E.C.

MOBBERLEY & PERRY,

GAS RETORT, FIRECLAY AND BRICK WORKS,

STOURBRIDGE.

MANUFACTURE EVERY KIND OF FIRECLAY GOODS,

Inclined, Horizontal, and Segmental Retorts of Best Quality.

LARGE STOCKS KEPT.

GEORGE ORME & CO.

(BRANCH OF METERS LIMITED),

ATLAS METER WORKS,

Telegraphic Address: "ORME, OLDHAM."
Telephone No. 93, OLDHAM.

PARK STREET, OLDHAM.

"NEW CENTURY" PATTERN PATENT COIN PREPAYMENT GAS-METERS

FITTED WITH DETACHABLE ATTACHMENTS.

ARRANGED FOR 1d., 6d., 1s., OR ANY OTHER COIN DESIRED.

These Meters are giving Universal Satisfaction wherever adopted.

Dry Meter in Tin-Plate Case, fitted with Attachment.

Price changed *in situ* by means of one Crown Wheel only.

COMPACT,

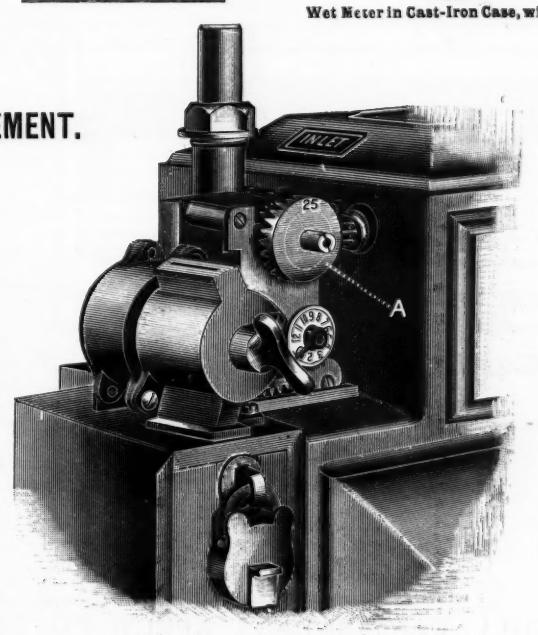
DURABLE,

RELIABLE,

SIMPLE.

Wet Meter in Cast-Iron Case, with Attachment Removed

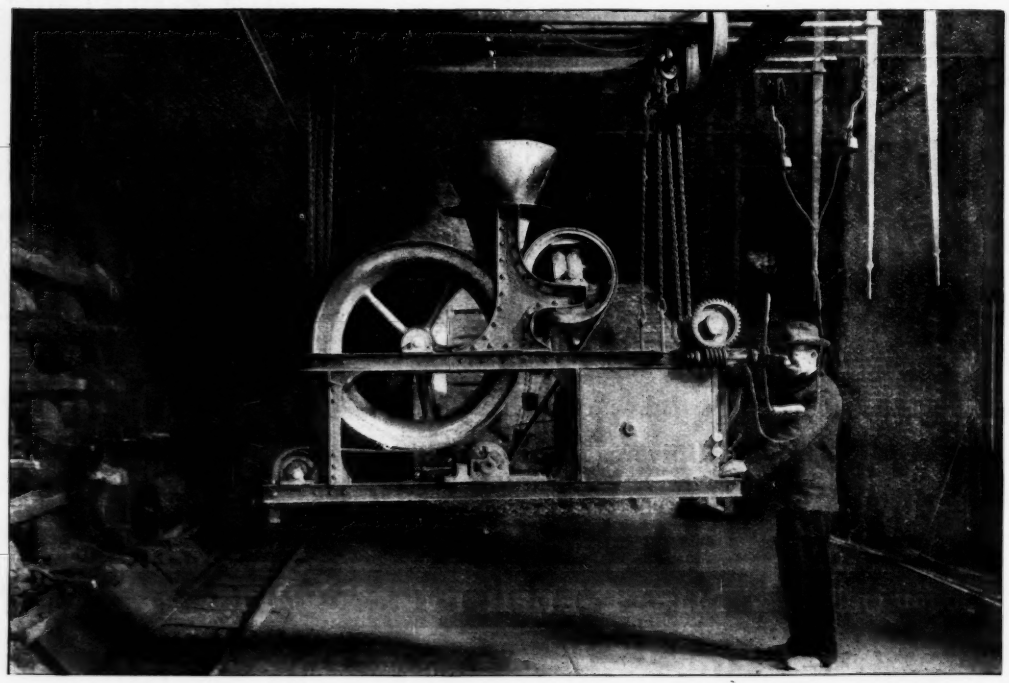
VIEW OF PRICE-CHANGING ARRANGEMENT.



CHANGE OF PRICE EFFECTED BY SIMPLY REMOVING CROWN WHEEL "A" AND REPLACING SAME WITH ANOTHER WHEEL.

ANY FURTHER PARTICULARS WILL BE SUPPLIED UPON APPLICATION.

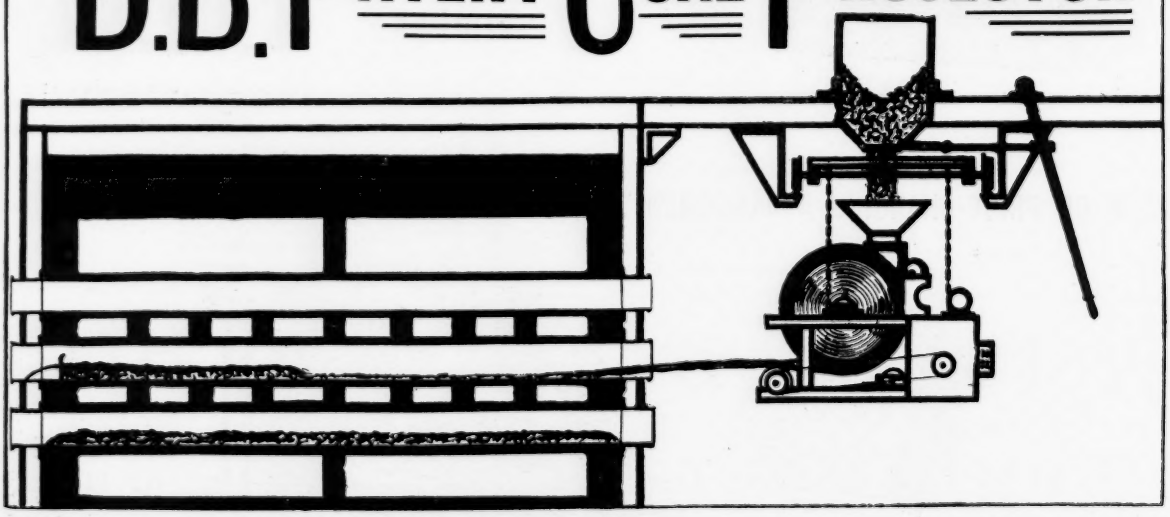
W. J. JENKINS & CO., LIMITED.



REPRODUCTION OF A PHOTOGRAPH OF THE DE BROUWER CHARGING-MACHINE AT BRUGES.

ALSO SOLE MANUFACTURERS
OF THE
"DE BROUWER" PATENT HOT COKE CONVEYOR.

THE D.B. PATENT COAL PROJECTOR



WHAT IS IT?

IT is the Simplest, the Cheapest, and the most perfect Retort Charging Machine ever invented. **IT** is a power Driven Machine. **IT** is suitable for the smallest as well as the largest Gas-Works. **IT** will charge Retorts 20 feet long as well as shorter ones from one end. **NO** part of the Machine enters the Retort nor comes within 4 feet of it. **ENORMOUS** savings in labour, in wear and tear, and in first cost. **IT** will charge upwards of 240 Retorts per hour.

FOR FULL PARTICULARS APPLY TO SOLE MANUFACTURERS,

W. J. JENKINS & CO., Ltd., RETFORD.

LATEST IMPROVEMENTS.

SULPHATE of AMMONIA APPARATUS

SHOWING BEST RESULTS.

TAR STILLS. ACID PUMPS. AIR COMPRESSORS.

Economy in Working.

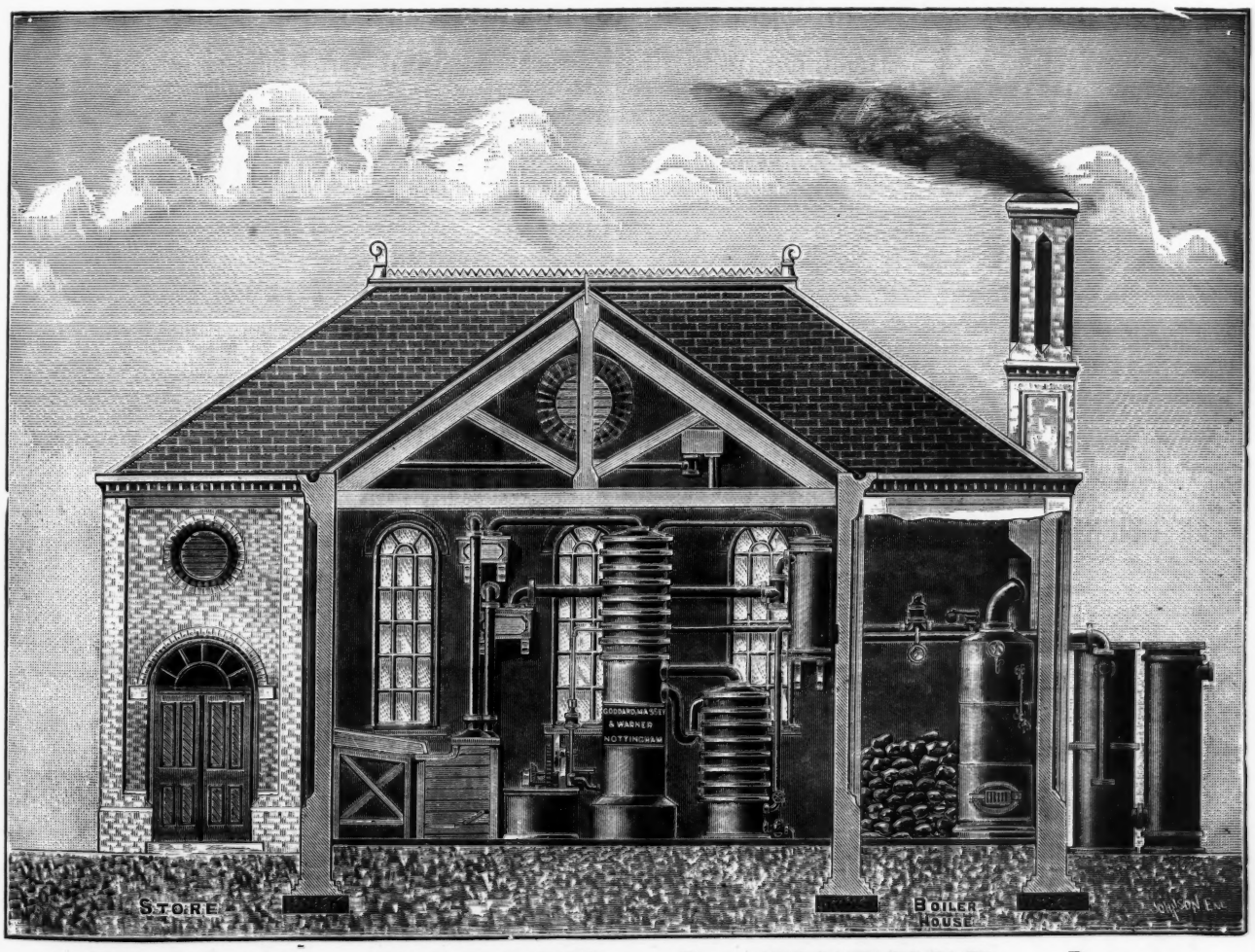
All Ammonia Recovered.

Small Quantity of Steam.

DURABLE. EFFICIENT. NO NUISANCE.

MAKERS OF ELLERY'S PATENT SATURATOR.

PUMPS, BOILERS, ROOFS, TANKS, &c.



GODDARD, MASSEY, & WARNER, LTD.,

NOTTINGHAM.

The ANTI-VIBRATION INCANDESCENT LIGHTING CO., LIMITED,

ARE THE PIONEERS OF INCANDESCENT GAS LIGHTING, THE "AVIL" SYSTEM HAVING STOOD THE TEST OF NINE YEARS.

It has in hundreds of cases been the means of keeping out electric light, and has in many cases enabled the incandescent gas to **displace** electricity.

The "Avil" system has been proved an immense success and is now recognized as indispensable to incandescent gas lighting, and a proof of this is in the various imitations of a cheap and inferior nature.

ANTI-VIBRATORS	**for**		**Factory**	**Lighting.**
,,	,,	,,	**Street**	,,
,,	,,	,,	**Church**	,,
,,	,,	,,	**School or Shop**	,,
,,	,,	,,	**Hotel**	,,
,,	,,	,,	**Billiard Table**	,,

ANTI-VIBRATORS FOR ANY AND EVERY PLACE WHERE VIBRATION EXISTS FROM STREET TRAFFIC, RAILWAY TRAFFIC, MACHINERY, OR ANY CAUSE WHATEVER.

The A. V. I. L. Co., Ltd., are Sole Owners and Manufacturers under Patents 19462 / 23715 } 1894, 30560—1897. 11663—1902.

HEAD OFFICE & WORKS: **35, KIRKSTALL ROAD, LEEDS.**

NAT. TEL. 116. TELEGRAPHIC: "RESILIENT, LEEDS."

47, FETTER LANE, LONDON, E.C.; VICTORIA ARCADE, MANCHESTER; MORLEY STREET, BRADFORD.

IN CONSEQUENCE

OF PRESSURE OF ORDERS FOR

THE "POSITIVE"

Prepayment Meter,

AND THE INCREASE OF OUR

BUSINESS GENERALLY, WE HAVE

BEEN COMPELLED TO OPEN A

BRANCH WORKS,

AT

GREAT FREEMAN ST.,

NOTTINGHAM.

Prompt Attention

IS ENSURED TO ALL ORDERS SENT TO EITHER THE

Manchester or Nottingham Works.

SAWER & PURVES,

MANCHESTER.

B. GIBBONS, JUNR.,

LIMITED,

DIBDALE FIRE-CLAY WORKS,

Telegraphic Address:
"MACHINE
LOWER GORNAL."

DUDLEY.

Telephone:
No. 10
DUDLEY.

The Largest Manufacturers in the Kingdom of

MACHINE-MADE GAS-RETORTS.

Patentees of

MACHINE-MADE FLANGES

By our process the Flange of the Retort can be made in the **MACHINE** at the same time as the Body, the whole being then of one consistency, which has great advantages over the process of Flanging by hand.

MACHINE-MADE SLOPERS

TAPERED OR PARALLEL.

By our improved methods we make these retorts perfectly smooth on the Interior. The Die for making Tapered Retorts mechanically expands as the Retort is made, thus ensuring a perfectly gradual increase of area, which is almost impossible with hand moulding.

MAKERS OF

REGENERATIVE TILES OF EVERY WELL-KNOWN SYSTEM.
LARGE STOCKS OF ORDINARY FLUE COVERS, BURRS,
BOILER-SEATING BLOCKS,
RABBETTED AND PLAIN TILES, HAND MOULDED AND PRESSED BRICKS OF ALL DESCRIPTIONS.

QUOTATIONS SENT ON APPLICATION.

STEWARTS AND LLOYDS,

LIMITED,

MANUFACTURERS OF

WROUGHT-IRON WELDED

TUBES and FITTINGS

OF ALL DESCRIPTIONS FOR

GAS, STEAM, AND WATER.

LIGHT LAP-WELDED WROUGHT-IRON AND STEEL TUBES

WITH STEWART'S PATENT FLANGED JOINTS.

HOT WATER HEATING TUBES

(PERKIN'S SYSTEM).

SOLID DRAWN STEEL TUBES

CAST-IRON PIPES

STEEL AND IRON PLATES FOR BOILERS, BRIDGES, &c.

OFFICES:

41, Oswald St., Glasgow,

AND

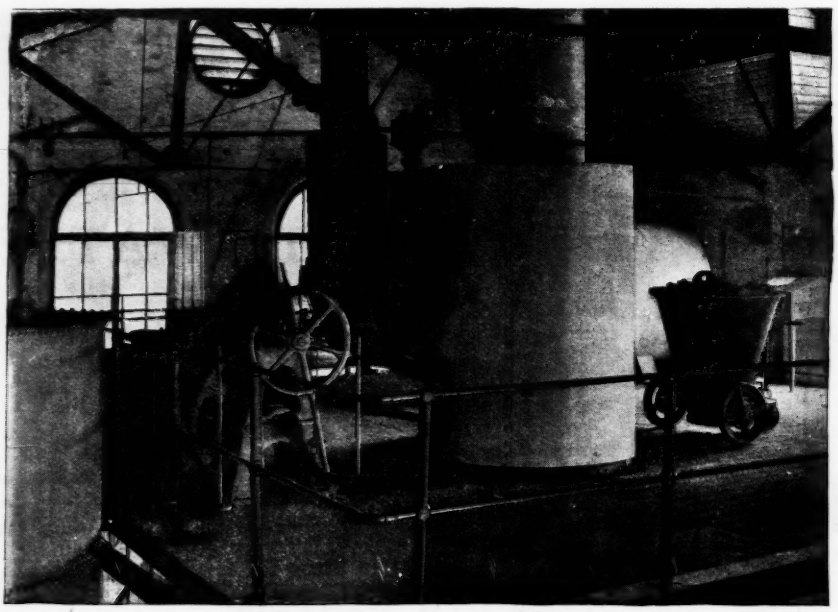
Nile St., Birmingham.

WATER GAS

THE DELLWIK-FLEISCHER PROCESS.

FOR INCREASING THE CAPACITY OF COAL-GAS WORKS.

Also for Incandescent Lighting, Driving of Gas-Engines, and Manufacturing Purposes.



WEST BROMWICH.

PATENTS IN ALL COUNTRIES.

THIS PROCESS HAS BEEN ADOPTED AT THE FOLLOWING GAS-WORKS—

IN ENGLAND—WEST BROMWICH, ILFORD, TIPTON, CLEETHORPES, BILSTON, RUSHDEN and HIGHAM FERRERS.

IN THE COLONIES—CAPE TOWN.

ON THE CONTINENT—KÖNIGSBERG, ISERLOHN, LYONS, ERFURT, REMSCHEID, BERNE, PFORTZHEIM, PLAUEN, BARMEN-RITTERSHAUSEN, NUREMBERG, MÜLHEIM A. RUHR, ARNHEIM, GIJON, ROME, BRUMMEN*, OSTERFELD*, WARSTEIN*, WIBORG*.

(*Blue Water Gas with Incandescent Burners.)

Also 40 Installations for Manufacturing Purposes.

THE DELLWIK-FLEISCHER WATER GAS SYNDICATE,

25, Victoria Street, Westminster, London, S.W.

THE WHESSOE

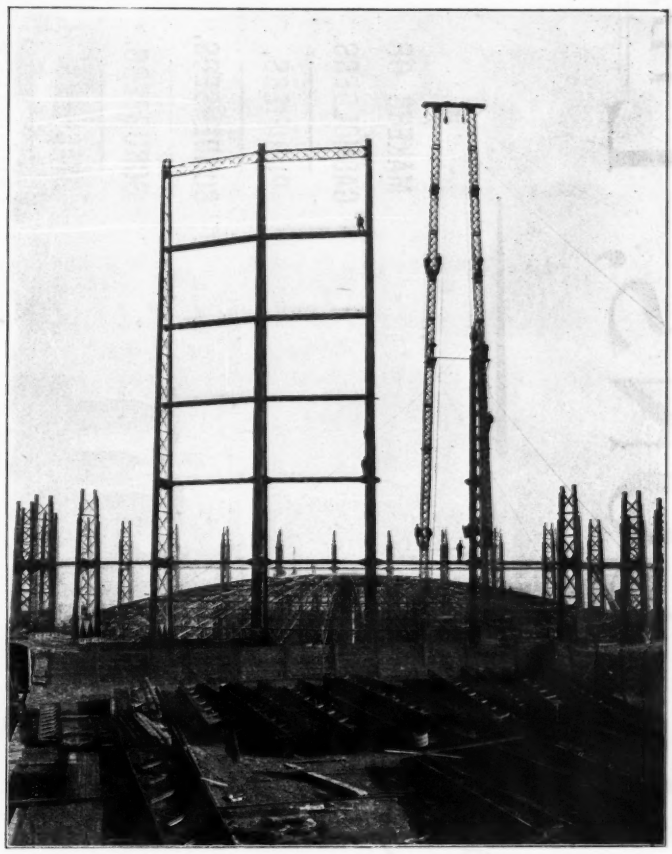
FOUNDRY CO., LTD.

Works: DARLINGTON.

London Office: 106 CANNON STREET, E.C.

MAKERS OF

EVERY DESCRIPTION OF GAS PLANT.



PHOTOGRAPH OF THREE-LIFT HOLDER

FOR

NEWCASTLE AND GATESHEAD GAS CO.

TAKEN DURING ERECTION.

CAPACITY 6 MILLION CUB. FT.

DIA. 236 FEET. HEIGHT 133 FEET.

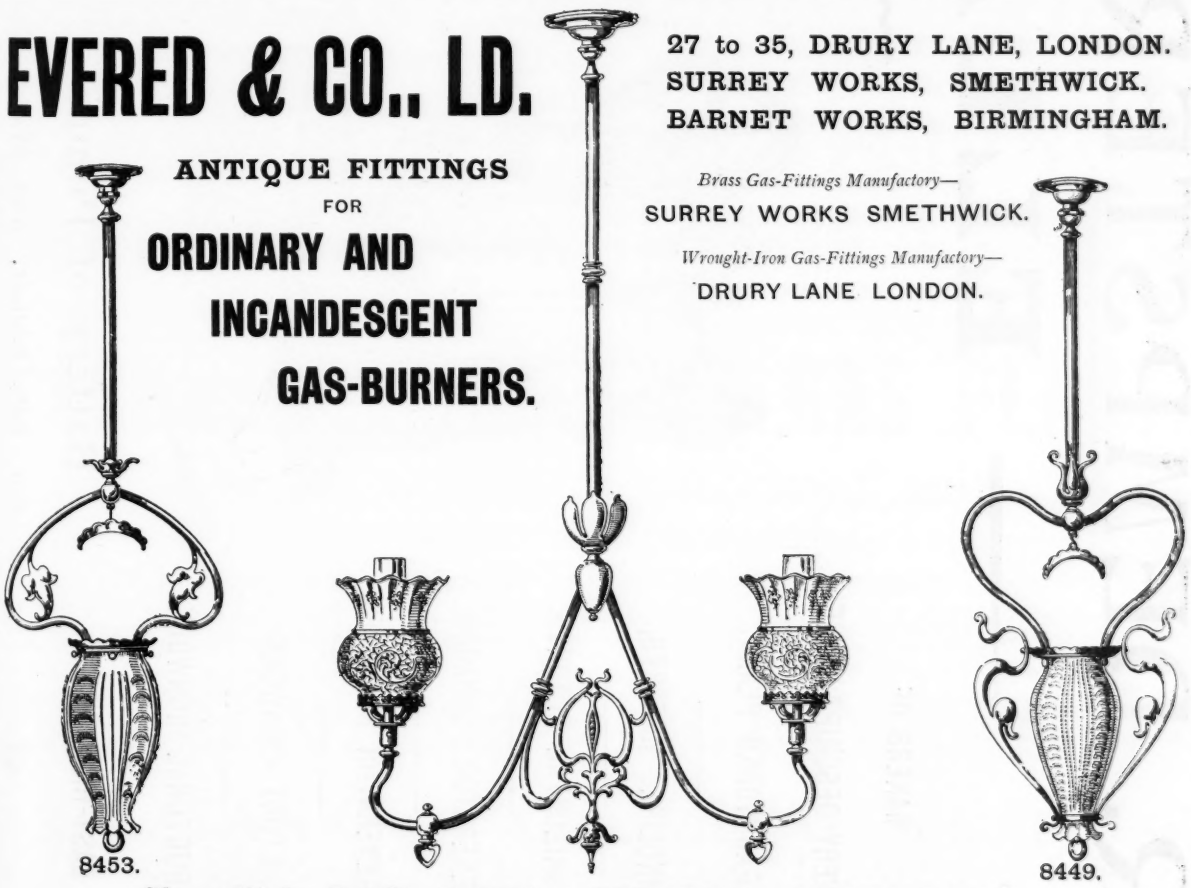
EVERED & CO., LD.

27 to 35, DRURY LANE, LONDON.
SURREY WORKS, SMETHWICK.
BARNET WORKS, BIRMINGHAM.

Brass Gas-Fittings Manufactory—
SURREY WORKS SMETHWICK.

Wrought-Iron Gas-Fittings Manufactory—
DRURY LANE LONDON.

ANTIQUE FITTINGS
FOR
ORDINARY AND INCANDESCENT GAS-BURNERS.



8453. 8449.

Shoreditch Depôt—143, HIGH STREET.

R. DEMPSTER & SONS, LTD.,

ELLAND.

MAKERS OF
EVERY DESCRIPTION OF
GAS-WORKS PLANT,

INCLINED RETORTS,

HORIZONTAL RETORTS,

GENERATOR FURNACES,

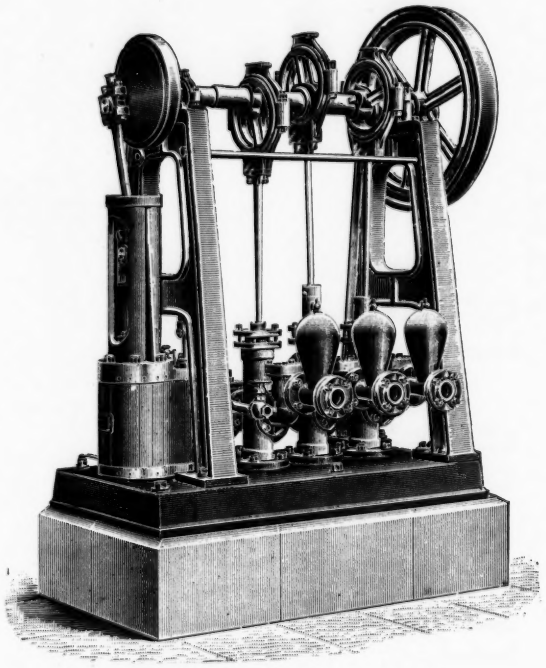
REGENERATOR FURNACES,

RETORT IRONWORK,

STRUCTURAL IRONWORK,

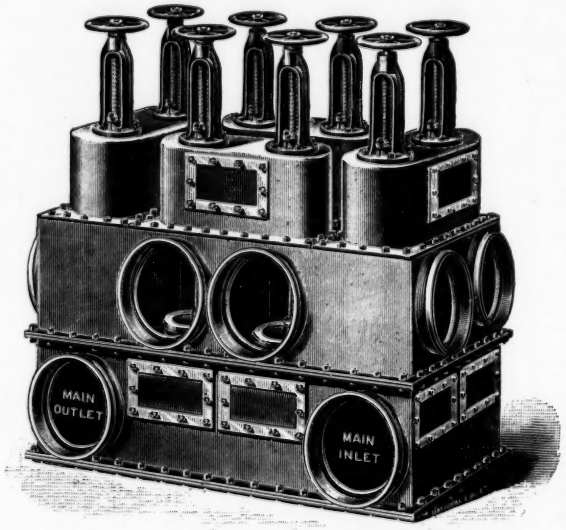
CAST-IRON WORK,

&c.



Battery of Pumps

For Tar, Liquor, and Water.



Weck's Centre-Valves.

Eight-Way, Six-Way, or Four-Way.

MAKERS OF
GASHOLDERS,

PURIFIERS,

CONDENSERS,

SCRUBBERS,

WASHERS,

EXHAUSTERS,

PUMPS,

VALVES,

COAL ELEVATORS,

COKE ELEVATORS,

CONVEYORS,

SCREENING PLANTS,

&c.

SAML. CUTLER & SONS. MILLWALL, [LONDON.

GASHOLDERS OF EVERY DESCRIPTION.

CUTLER'S PATENT GUIDE FRAME FOR GASHOLDERS

Adopted for many large and important Gasholders.

CUTLER'S PATENT FREEZING PREVENTER

FOR GASHOLDER CUPS AND TANKS.

In extensive use in English, Continental, and American Works.

LARGE STEEL TANKS A SPECIALITY

Gasworks Plant of every kind.

STEEL FRAMED BUILDINGS.

RETORT-HOUSE ROOFS. BENCH IRONWORK.

CARBURETTED WATER GAS PLANT.

CUTLER'S PATENT INTERLOCKING GEARS.
CUTLER'S PATENT OIL SPRAYERS.
CUTLER'S PATENT TAR SEPARATOR.
CUTLER'S PATENT DUST INTERCEPTOR.

PATENT WATER TUBE CONDENSERS

OIL-TANKS. CHEMICAL PLANT.

Makers of all kinds of Constructional Ironwork.

THE "HOPPER"
Weighing
Machines
USED WITH
THE
Coal Storage Plant

AT
Ipswich
Gas-Works—
See "JOURNAL OF GAS LIGHTING," for December 2, 1902—
were made by

HENRY POOLEY & SON, LTD.,

HEAD OFFICE: TEMPLE STREET, BIRMINGHAM;
AND AT
89, Fleet Street, London, E.C., & 25, South Kinning Place, Glasgow, &c.

Telephone No. 103. Telegraphic Address: "ELEVATOR, HASLINGDEN."

S. S. STOTT & CO.,

ENGINEERS, HASLINGDEN, NR. MANCHESTER.

COAL AND COKE ELEVATORS & CONVEYORS.

COAL AND COKE STORAGE PLANTS.

COAL AND COKE BREAKERS.

WHARF ELEVATORS FOR UNLOADING BARGES.

ELEVATORS & CONVEYORS for BOILER-HOUSES.

STAMPED AND RIVETED STEEL ELEVATOR BUCKETS.

DETACHABLE CHAINS AND SPROCKET WHEELS.

Coke Elevator Loading Railway Waggons.

LIME AND OXIDE ELEVATORS & CONVEYORS.

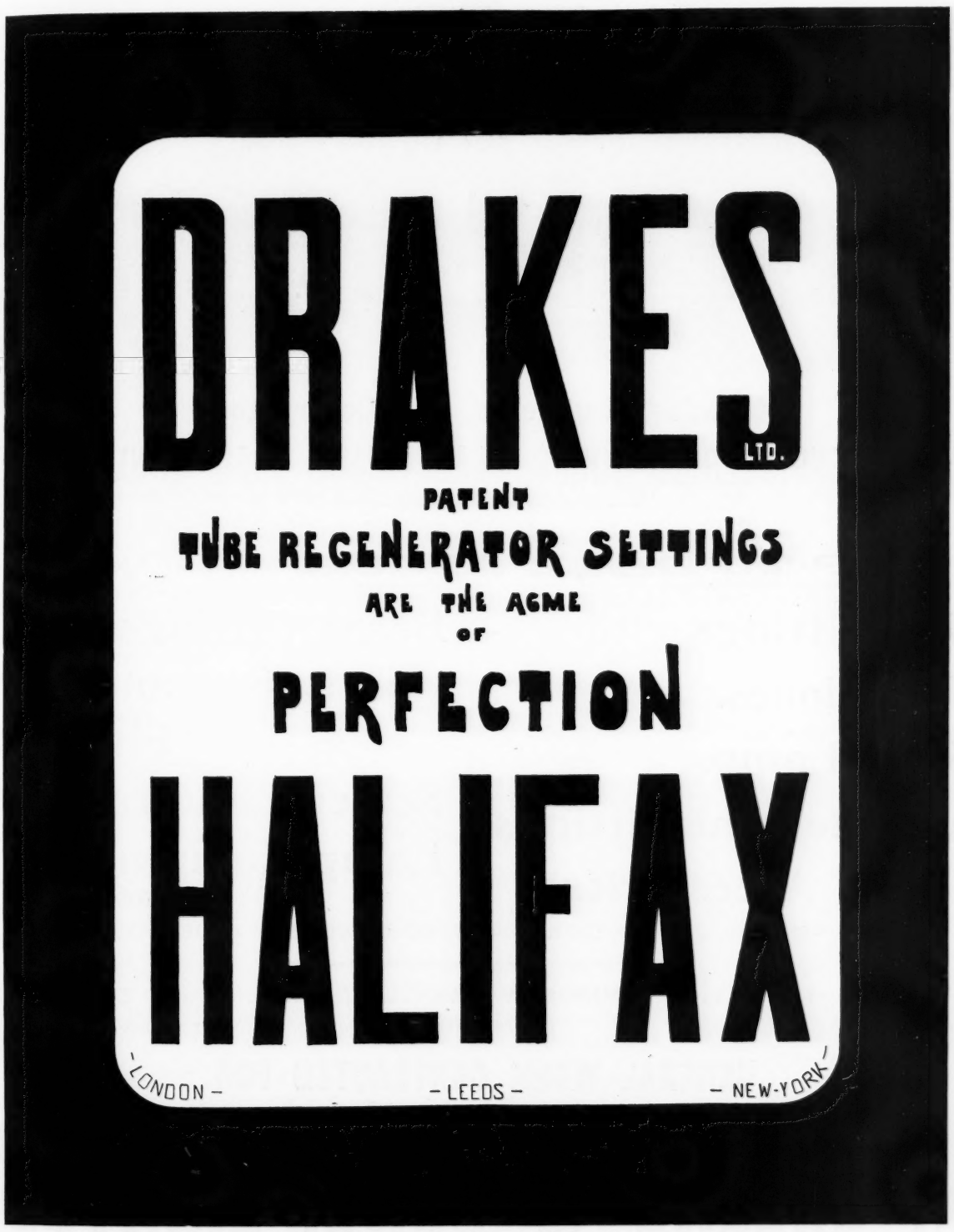
HIGH-CLASS STEAM-ENGINES up to 1000-Horse Power.

PUMPS, HORIZONTAL AND VERTICAL, SINGLE, DOUBLE, or THREE-THROW, for WATER-WORKS, &c.

BEAM PUMPING-ENGINES.

AIR-COMPRESSORS.

BELT PULLEYS, ROPE PULLEYS, GEARING, &c., &c.


DRAKES
LTD.
PATENT
TUBE REGENERATOR SETTINGS
ARE THE ACME
OF
PERFECTION
HALIFAX
LONDON
LEEDS
NEW-YORK

Lighting Engineers and Contractors,

SURREY ENGINEERING WORKS, BLACKFRIARS ROAD, LONDON, S.E.

Before buying elsewhere, kindly call and inspect our

UP-TO-DATE STOCK of General Goods.

Gas Fittings.
Gas Globes.
Shop Lamps.
Incandescent Fittings and Accessories.

Brass Fittings.
Gas Barrel and Fittings.
Street Lanterns.
Lamp Columns,
&c., &c.

SPECIAL DESIGNS CARRIED OUT TO CUSTOMERS' ORDERS.

Sole owners of the **"LUMINOSITY" MANTLE** for Interior and Exterior Incandescent Lighting. Extra Strong and of Unsurpassed Brilliancy.

GENERAL WORK CONTRACTED FOR.

H. GREENE & SONS, LIMITED,

SURREY ENGINEERING WORKS,

BLACKFRIARS ROAD, LONDON, S.E.

Telegrams for Lighting Department: "LUMINOSITY, LONDON." Telephone 1693 HOP.

Chemical Engineers and Manufacturers,

SURREY ENGINEERING WORKS, BLACKFRIARS ROAD, LONDON, S.E.

Works Fitted Complete, at Home and Abroad.

CONTRACTORS FOR THE SUPPLY & ERECTION OF TAR WORKS AND COMPLETE BYE-PRODUCTS. RECOVERY PLANT.

APPARATUS FOR THE MANUFACTURE OF AMMONIA PRODUCTS, INCLUDING SULPHATE, MURIATE, NITRATE, LIQUID, ANHYDROUS, SALAMMONIAC, &c

SULPHURIC ACID WORKS ACID CONCENTRATING PLANT, LEAD SATURATORS, INJECTORS, ACID VALVES AND COCKS, &c. DRYING MACHINES.

CONVEYORS AND ELEVATORS SPECIALLY DESIGNED FOR THE ABOVE PRODUCTS. ALL APPARATUS APPERTAINING TO THE CHEMICAL INDUSTRY.

SULPHATE OF AMMONIA SATURATORS

OF THE MOST MODERN CONSTRUCTION.

The following Plants have recently been erected by our Mr. Maurice Schwab—

SOUTH METROPOLITAN GAS COMPANY.
MANCHESTER CORPORATION GAS-WORKS.
MESSRS. BURT, BOULTON, & HAYWOOD, LTD., SILVERTOWN, E.
MARGATE GAS-WORKS.
LONGPORT GAS-WORKS.
COLTNESS IRON CO., NEWMAINS.
DOUGLAS GAS-WORKS.
WORTHING GAS-WORKS.
FOLKESTONE GAS CO.

H. GREENE & SONS, LIMITED,

SURREY ENGINEERING WORKS,

BLACKFRIARS ROAD, LONDON, S.E.

Telegrams for Engineering Department: "OWSTON, LONDON." **Telephone 1693 HOP.**

J. TAYLOR & CO.,

Central Plumbing Works,

BOLTON.

Telegrams: "SATURATORS, BOLTON." **Telephone No. 0848.**

When Ordering

PLATE LEAD SATURATORS,

See that you get them, and not Cast ones—

we are taking them out.

INSIST ON GUARANTEE,

THE TRUE TEST OF QUALITY.

J. & H. ROBUS,

GAS ENGINEERS AND CONTRACTORS FOR GAS AND WATER WORKS.

City Office: 20, BUCKLERSBURY, LONDON, E.C.

Telegraphic Address: "ROBUSTNESS, LONDON." Telephone No. 756 BANK.

Gasholders. Tanks. Mainlaying.

RETORT-SETTINGS.

HIGHEST CLASS—LATEST IMPROVEMENTS.

"Duration"

5,000,000 TO 10,000,000 CUBIC FEET.

30 YEARS' REPUTATION.

CONTRACTS ENTERED FOR CONSTRUCTION

AND EFFICIENT REPAIRS

FOR

1000 DAYS' WORKING.

REGENERATORS,

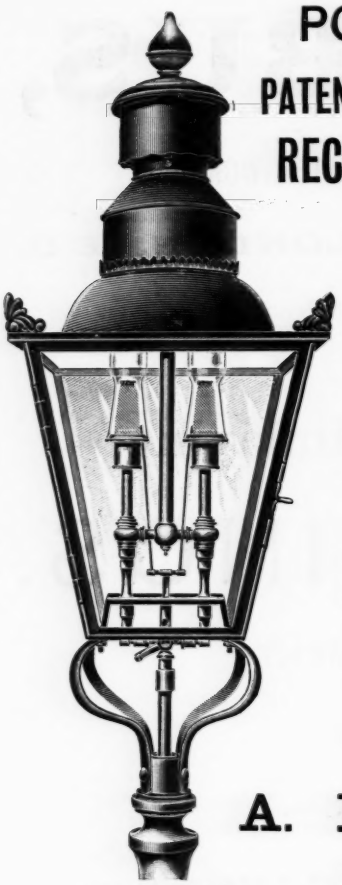
GENERATOR, AND FLOOR-LEVEL COMPLETE.

SPECIALITY—COMPLETE INSTALLATIONS, INCLUDING

RETORT-HOUSES, CONVEYORS, ELEVATORS, &c., &c.

INCLINES.

PLANS AND SPECIFICATIONS.



LEEK COUNCIL LAMP.

PODMORE & THOMAS' PATENT LOW-PRESSURE HIGH-POWER RECUPERATIVE INCANDESCENT GAS LIGHTING SYSTEM.

DUST AND INSECT PROOF.

The highest efficiency yet obtained from Low Pressure Incandescent Gas Lighting without mechanical aid.

Made in suitable sizes and any design to enable Lighting Authorities to successfully compete with Electric Light. Also made as Ventilating Lights.

Can be adjusted to suit any QUALITY of Gas.

A. E. PODMORE & CO.,

25A, HATTON GARDEN, E.C.

BLACKPOOL LAMP.

F. C. SUGDEN & CO.

CARBONIZING SPECIALISTS.

Regenerator and Generator Settings,

DEEP, SEMI-DEEP, AND SHALLOW.

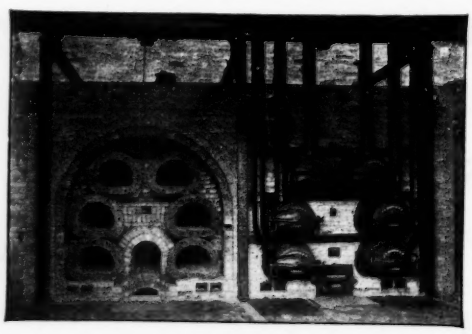


PHOTO. OF REGENERATOR SETTINGS DURING CONSTRUCTION.

Telephone No. 686.
Tel. Address: "CARBONIZER, LEEDS."

Maximum Make per Ton and Mouthpiece.
Minimum Fuel Consumption.

NUMEROUS REPEAT ORDERS

Have been received for each of the above types of Settings.

RESULTS GUARANTEED. RETORTS RESET.

Sole Makers of
Cripps' Patent Chimney.

Designs and Estimates on Application.

28, EAST PARADE, LEEDS.

"BRAY" BURNERS.

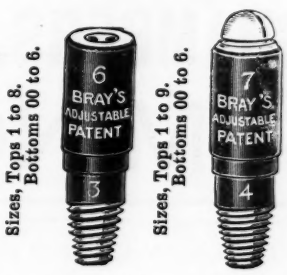
"SPECIALS."

Union-Jet. Slit-Union.

"SPECIALS" For Globe Holders.

Union-Jet. Slit-Union

"ADJUSTABLE SPECIALS."



Union-Jet. Slit-Union.

"MARKETS."

Union-Jet. Batswing.

"REGULATORS."

Union-Jet.

Batswing.

"GAS ECONOMISERS."

Slit-Union.

Slit-Union.

"GEYSER" BURNERS.

These Burners are specially Strong so as to take the grip of the pliers without injuring the tips. For use in "Geysers" and the like.

Sizes, Union Jets, 00 to 7.

SEND FOR OUR 1902 BLUE BOOK.

THE "BRAY" INCANDESCENT MANTLE.

(LICENSED.)

MADE OF RAMIE. TOUGH & UNSHRINKABLE.

A Pure White Light of Exceptional Brilliancy.

SEND FOR PRICE LIST.

GEO. BRAY & CO., LTD., Gas Lighting Engineers,

BAGBY WORKS (OFF BLACKMAN LANE),

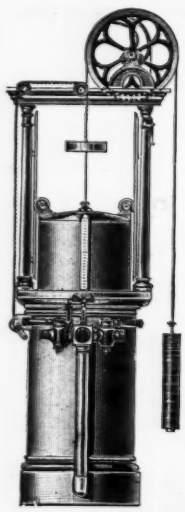
LEEDS.

THOS. CASH, SON & CO.,

Gas Coal and Cannel Proprietors,

WARWICK CHAMBERS, CORPORATION ST.,

BIRMINGHAM.



CONSUMERS' WET AND DRY GAS-METERS.

PREPAYMENT WET AND DRY GAS-METERS.

STATION GOVERNORS.

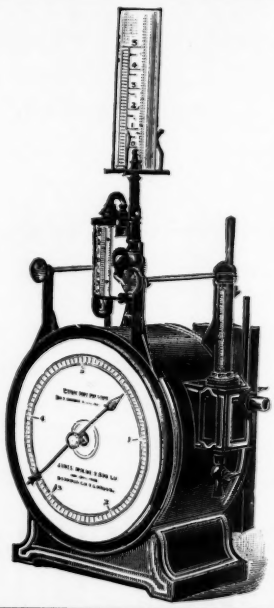
PRESSURE REDUCERS.

ENGINES AND EXHAUSTERS.

TEST HOLDERS.

VALVES.

PRESSURE GAUGES.



JAMES MILNE & SON, LD.

Milton House Works, EDINBURGH.

60, HOLBORN VIADUCT, LONDON. | 48, WELLINGTON STREET, LEEDS. | 111, ST. VINCENT STREET GLASGOW.

BUILDING TRADES' EXHIBITION,

AGRICULTURAL HALL, ISLINGTON, N.

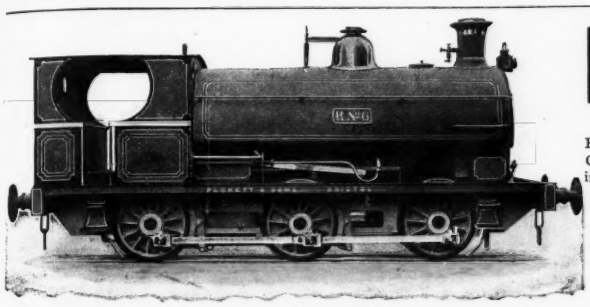
JUNE 13TH TO JUNE 20TH, INCLUSIVE.

BOROUGH ENGINEERS and others interested in Refuse Destructors, and smoke burning appliances, are invited to call at our **Stand** in the "**Surveyor Section**" in Gallery.

Complimentary Tickets will be sent to those desirous of attending.

MELDRUM BROS., LTD., TIMPERLEY, MANCHESTER.

And at 66, VICTORIA ST., WESTMINSTER, S.W.



LOCOMOTIVES

LOCOMOTIVES of all Sizes and Gauges specially constructed for Main and Branch Lines, Contractors, Docks, Gas-Works, Collieries, Iron-Works, Brick and Cement Works, &c. Locomotives of various Sizes always in Stock, ready for immediate Delivery.

Photographs, Specifications, and Prices on Application.

PECKETT & SONS, Atlas Locomotive Works, **BRISTOL.**

Telegraphic Address: "PECKETT, BRISTOL."

JOHN BROWN & CO., LTD., SHEFFIELD.

Proprietors of

ALDWARKE MAIN, CAR HOUSE & ROTHERHAM MAIN COLLIERIES, NEAR ROTHERHAM.

ALDWARKE MAIN GAS COAL

Analysis: 12,600 Feet of 19-Candle Gas per Ton.

Value in Pounds of Sperm, 820·80.

VERY FREE FROM IMPURITIES.

TELEGRAMS: "ATLAS, SHEFFIELD."

D. HULETT & CO., LTD.

55 & 56, High Holborn, London.

GAS SERVICE CLEANSERS.

LAMP TORCHES.

DRY GAS-METER MAKERS.

WROUGHT-IRON TUBES & FITTINGS.

STREET LAMPS & POSTS.

PRICE LISTS ON APPLICATION.

HUTCHINSON BROTHERS & CO., LTD.,

MAKERS OF

CONSUMERS' WET AND DRY GAS-METERS.

Brass Main Taps, Lamp Taps, Unions, Ferrules, &c., &c.

SERVICE CLEANERS. SYPHON PUMPS.

LEAD WORK for SULPHATE of AMMONIA PLANT.

CHEMICAL LEAD BURNING APPARATUS. COPPER SCOOPS.

PURIFIER GRIDS. TOOLS AND SUNDRIES FOR GAS-WORKS.

FALCON WORKS, SACKVILLE ST., BARNSLEY.

Telegrams: "HUTCHINSON BROS., BARNSLEY." Telephone 54 National.

HISLOP'S PATENT RETORT SETTINGS

THE RESULTS GUARANTEED ARE CERTIFIED
TO EXCEED THOSE OF ANY OTHER SYSTEM.

R. & G HISLOP,
Gas Engineers and Contractors,
13, ST. JAMES PLACE,
PAISLEY.

"DURA" "DURA"

INCANDESCENT GAS MANTLE

SECOND TO NONE.

Unexcelled.

The "**DURA**" Mantle is now made of the best 3-ply **Ramie** of English Manufacture.

The "**DURA**" Mantle is of **English** Manufacture throughout.

The "**DURA**" Mantle is sold to Plumbers, Gas-Fitters, and Retail Ironmongers through the usual Wholesale Houses.

Unshrinkable.

The "**DURA**" Mantle is Manufactured and sold under License.

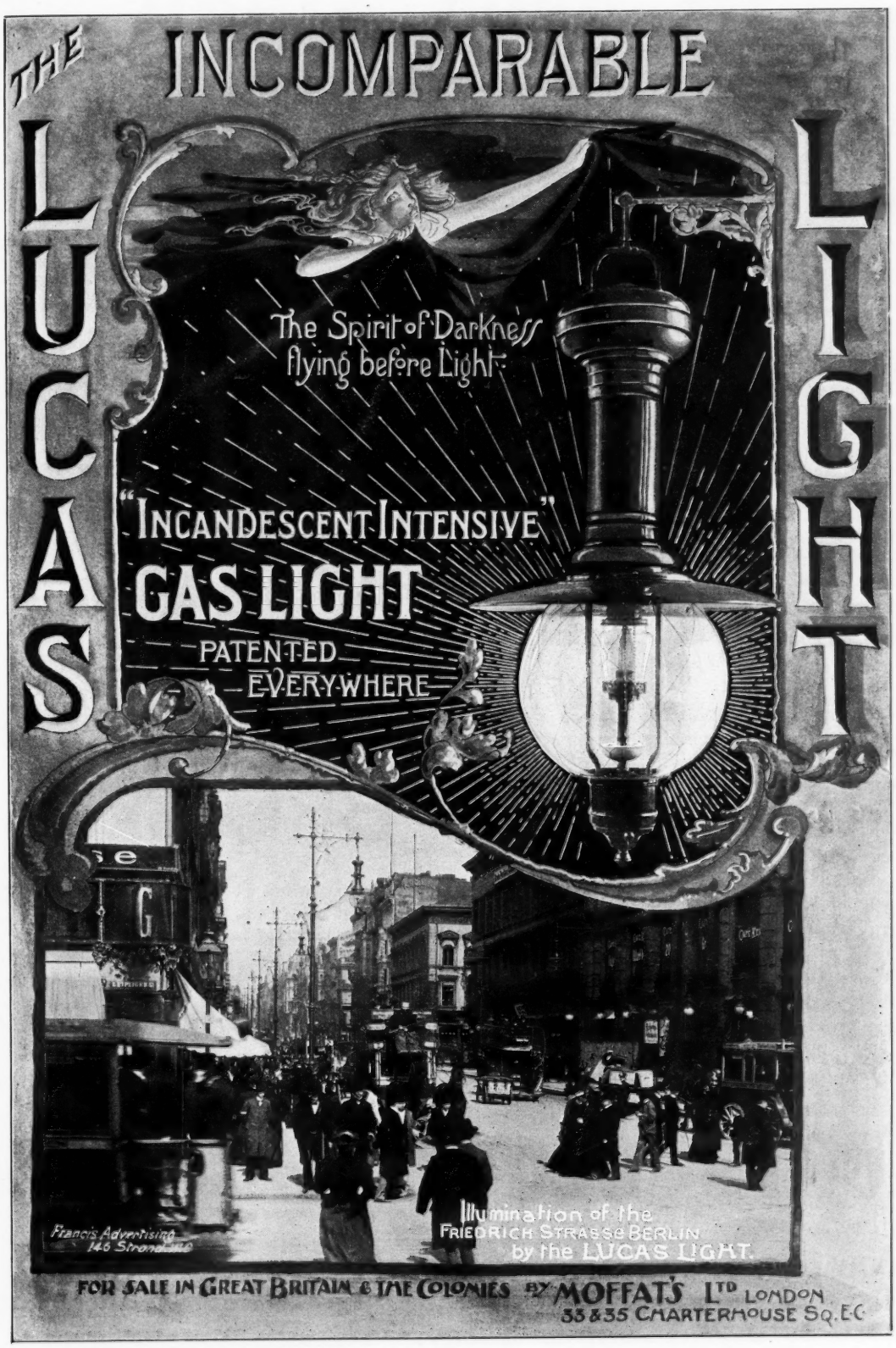
The "**DURA**" Mantle is made in all sizes.

The Company continue to make the original "**DURA**" Mantle.

The new "DURA" Ramie Mantle is the best for Street-Lighting, and is therefore recommended to Gas Managers.

The Guaranty Incandescent Mantle Co., Ltd.,
Phœnix Works, STREATHAM, LONDON, S.W.

"DURA" "DURA"


THE INCOMPARABLE
LUCAS LIGHT
The Spirit of Darkness flying before Light
"INCANDESCENT INTENSIVE"
GAS LIGHT
PATENTED EVERYWHERE
Illumination of the FRIEDRICH STRASSE BERLIN by the LUCAS LIGHT.
Francis Advertising 146 Strand
FOR SALE IN GREAT BRITAIN & THE COLONIES BY MOFFAT'S LTD LONDON 33 & 35 CHARTERHOUSE SQ. E.C.

In writing us kindly mention this Journal.

OUR NEW ADDRESS—

Moffat's Ltd.,
155, Farringdon Road, E.C.

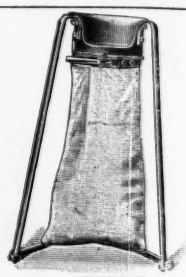
TYPE A.

THE SACK STAND

PATENTED AT HOME AND ABROAD.

A STRONG, DURABLE, & USEFUL TIME & LABOUR SAVER.

One man with it can do more than two men without it where any material has to be filled into sacks off a floor. It does not talk, does not lose time, and is always ready. The sack is easily and quickly fastened, and is held securely with the mouth wide open so that it is very easy to fill, and the air can get away (hence less dust), and is released instantly, falling on to the truck that may be placed beneath it. The stand cannot get out of order and does not wear out. The straps holding the sack are of best leather and the levers of steel. It saves the employer money, and saves the workman trouble.



TYPE B.

Chemical Works, Castleford.
It is quite satisfactory—send us another like it. HUNT BROS.

Gas Light Company's Office, Fraserburgh, 24th Oct., 1901.
The Sack Stand which you supplied to us some time ago does the work which it is intended for admirably. JAMES MATTHEW, Manager.

Sunderland, 29th Oct., 1901.
In reply to your favour, we beg to say that the Sack Stands are very useful, and suit our purpose in every way.
FOR THE WEAR FUEL WORKS CO., LTD.
W. DIXON, Secretary and Works Manager.

Goldfield Mill, Tring, 26th Oct., 1901.
I am well pleased with Sack Stand I received from you last May. I find there s a great saving in labour, one man can do as much as two in the ordinary way of filling, and makes less dust. JAMES WRIGHT.

Consumers' Gas Company, Gas-Works, Weymouth, 6th Dec., 1902.
We are very pleased with the Sack Stand you supplied us with; it is a useful and handy appliance.—I am, yours faithfully, J. LOWE.

Newcastle-on-Tyne, 4th Dec., 1902.
The Sack Stands supplied to our order have answered their purpose to our satisfaction.—Yours truly, For the UNITED ALKALI CO., LD. (Allhusen's Works).
ALFRED A. ALLHUSEN.

Enniskillen Gas Co., Enniskillen, 4th Dec., 1902.
I beg to say that the Sack Stand has been a great success, and one man can do the work now, where the horse and cart used to stand until we could get a second man to hold the bags, and now one man can fill, and another can cart away as hard as the horse can go, and has saved us both men and money in time and horseflesh.—Yours truly, T. HANDS.

Wyke, Bradford, 5th Dec., 1902.
In reply to yours *re* Sack Stand, we have been quite satisfied with the one we got from you some time ago. We are wanting another at present, so we will thank you to send it on, like last, and oblige.—Yours truly, S. BREAKS & SON.

Urban District Council of Teignmouth Gas Department, 6th Dec., 1902.
We have found the Sack Stand to be of great service on our works.—Yours truly, J. ALEX. GRAY.

Gas-Works, Bury, 3rd Dec., 1902.
I am very pleased with the Sack Stand; should not care to be without it now.—Yours truly, H. SIMMONDS, Engineer and Manager.

Worcester New Gas Light Co., Worcester, 4th Dec., 1902.
In reply to your letter of yesterday's date, I beg to say that I am very well satisfied with the Sack Stands, and find them extremely useful.—Yours faithfully, E. L. ADLINGTON.

Baxenden, 5th Dec., 1902.
We find the Sack Stands very useful, and admirably adapted for their purpose.—Yours truly, NICHOLS CHEMICAL CO.

Kildwick Parish Gas Co., Kildwick, 5th Dec., 1902.
I have nothing but praise to say of the Sack Stand. It does the work of a man, and does it better than a man could.—Yours respectfully, F. H. PICKLES.

Cleethorpes Gas Co., Cleethorpes, 9th Dec., 1902.
I consider your Sack Stand one of the most valuable labour-saving appliances we have on the works.—Yours truly, E. J. BROCKWAY.

Savile Town, Dewsbury, 20th Dec., 1902.
We are now able to say that the Sack Stand you supplied us with has so far given us every satisfaction. We find that by its use we can do the same amount of work with much less labour.—Yours truly,
PRO THE SAVILE TOWN CHEMICAL CO., LTD.,
W. C. WAKEFIELD, Manager.

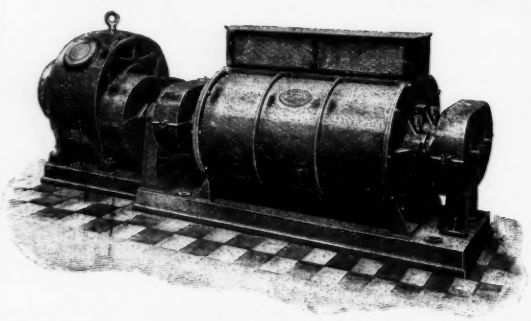
Burgh of Hamilton Gas-Works, Hamilton, 6th Dec., 1902.
We have now used your Sack Stand for a considerable time for filling sulphate of ammonia, and find it to answer the purpose exceedingly well. It is of great service for filling double bags, as it entirely prevents the sulphate from getting in between them. I consider it has already paid itself many times over, owing to fewer men being required for filling the bags.—Yours truly, J. BALLANTYNE.

SOME OTHER USERS.

The Corporation of Nottingham Gas-Works (four in use).
Anglo-Continental Guano Co., London and Hamburg.
Sanitas Company, Ltd., London.
Messrs. The Washington Chemical Co.
Messrs. Casebourne & Co., Ltd., Cement Works, W. Hartlepool.
,, Simon, Carves, & Co., and repeat order for 4.
,, Solvay & Co., Soda Manufacturers, Brussels, and repeat order for 14.
,, Brunner, Mond, & Co., Northwich, 8 (successive orders).

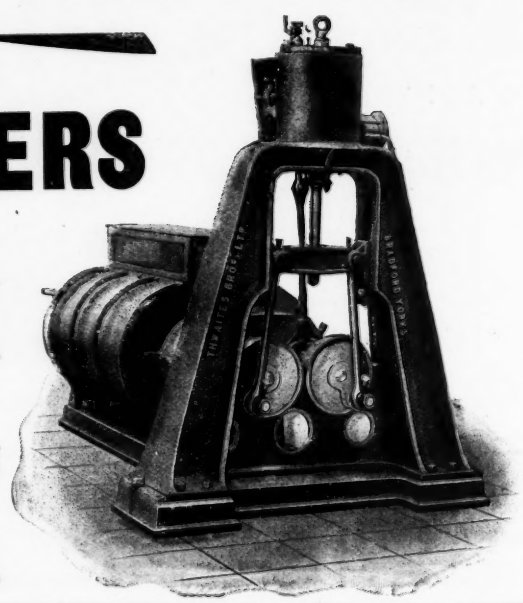
Patentee and Manufacturer:
RICHARD SIMON, Phœnix Works, NOTTINGHAM.

THWAITES BROS., LD.,



MECHANICAL ENGINEERS,

BRADFORD.



ROOTS' BLOWERS

IN ALL SIZES TO DELIVER UP TO

25,000 cubic feet of Air per minute.

Driven by Engine, Belt, or Motor.

SPECIALLY DESIGNED AND OF

MODERN CONSTRUCTION

. . For all Processes of . .

GAS MANUFACTURE.

CLAYTON SON & Co, LTD

MAKERS OF

WORKS LEEDS

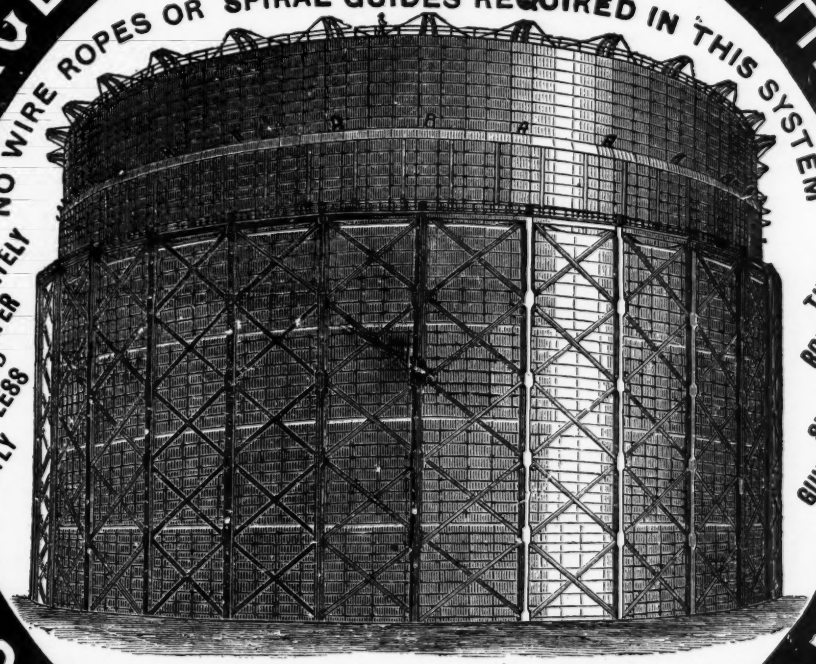
THE LARGEST GASHOLDER IN THE WORLD

CAPACITY 12 MILLION CUBIC FT.

GASHOLDERS OUR SPECIALITY

NO WIRE ROPES OR SPIRAL GUIDES REQUIRED IN THIS SYSTEM

INFINITELY SAFER AND FAR LESS COSTLY THAN ROPES OR SPIRAL GUIDES.



ERECTED AT EAST GREENWICH FOR THE South Metropolitan Gas Company

IT HAS SIX LIFTS 30 FT. DEEP EACH AND IS 300 FT. DIAR.

MAKERS OF GAS PLANT OF EVERY DESCRIPTION

ROOFS PURIFIERS &c. ALSO

ADDRESS LONDON 60, QUEEN VICTORIA ST.

TELEGRAPHIC "GAS, LEEDS.

GASHOLDERS OF ANY SIZE

ERECTED & COMPLETED WITHIN 12 MONTHS AND AT THE TIME SPECIFIED

MAKERS OF HIGH-CLASS

BOILERS

FOR GAS AND ELECTRIC LIGHT WORKS,

FITTED WITH DEIGHTON'S PATENT CORRUGATED FLUES.

These Flues give Greatly Increased Heating Surface, and are Specially Recommended for High-Pressure Boilers.

GANDY'S BELTING

Holds the World's Record! 41 Prize Awards!

IN A WATER-GAS PLANT, an important item is the Belt for driving the Blower.

We have recently had most gratifying success with our specially constructed endless Belts on most difficult Blower Drives, and beg to solicit enquiries from Gas-Works Managers respecting same, to which we shall give full and frank replies.

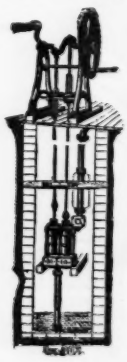
THE GANDY BELT MANUFACTURING COMPANY, LTD.,

HEAD OFFICES AND WORKS—SEACOMBE, LIVERPOOL.

This Trade Mark may be seen stencilled on every genuine "Gandy" Belt.

JOSEPH EVANS & SONS

CULWELL WORKS, WOLVERHAMPTON.



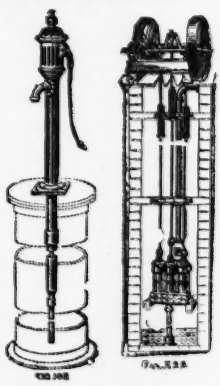
London Address:
Salisbury House, London Wall, London, E.C.

PLEASE APPLY FOR CATALOGUE No. 8.

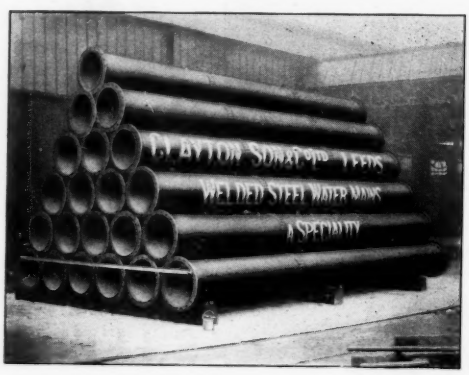
Telegrams:
"EVANS, WOLVERHAMPTON."
National Telephone No. 7089.

FIRST AWARDS

TRADE MARK. EVERYWHERE.



See next Week's Advertisement for Steam-Pumps, Tar and Liquor Pumps, &c.



WELDED OR RIVETED STEEL PIPES
A SPECIALITY

FOR ALL PURPOSES, TO STAND ANY PRESSURE AND PASS ANY INSPECTION.

CONTRACTS UNDERTAKEN FOR ANY LENGTH OF

PIPE LINE For Water, Steam, Oil, Hydraulic, or Pneumatic Pressure; also for Gas or Air. Any diameter from eight inches upwards.

COMPLETE GAS PLANTS.

ALSO MAKERS OF **STEEL STORAGE TANKS.**

Structural Iron & Steel Work,

HIGH-CLASS BOILERS,

For High Pressures, fitted with DEIGHTON'S PATENT CORRUGATED FLUES, giving increased heating surface and highest economy in working.

ON ADMIRALTY AND WAR OFFICE LISTS.

CLAYTON SON & Co LTD LEEDS.

HIGHEST AWARDS—LONDON, PARIS, COLOGNE, VIENNA, MELBOURNE, AND OTHERS.

—11 MEDALS.—

MANUFACTURERS OF TUBES AND FITTINGS OF EVERY DESCRIPTION.

WROUGHT-IRON OR STEEL MAINS UP TO 6 FEET DIAMETER, FOR GAS, WATER, OIL, OR OTHER PURPOSES.

SCREWING TACKLE. BOILER MOUNTINGS, VALVES, COCKS, ETC.

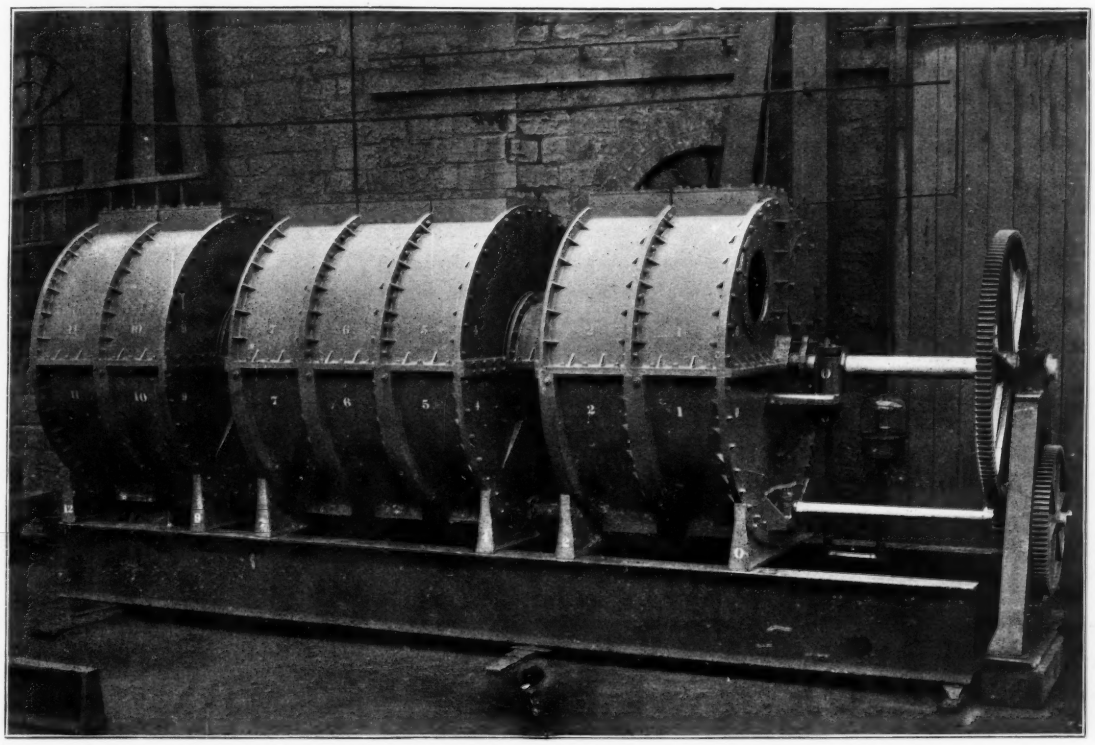
LONDON: 108, Southwark Street.
MANCHESTER: 33, King Street West.
BIRMINGHAM: 114, Colmore Row.
LEEDS: 6, Mark Lane, New Briggate.

KIRKHAM, HULETT, & CHANDLER, LTD.

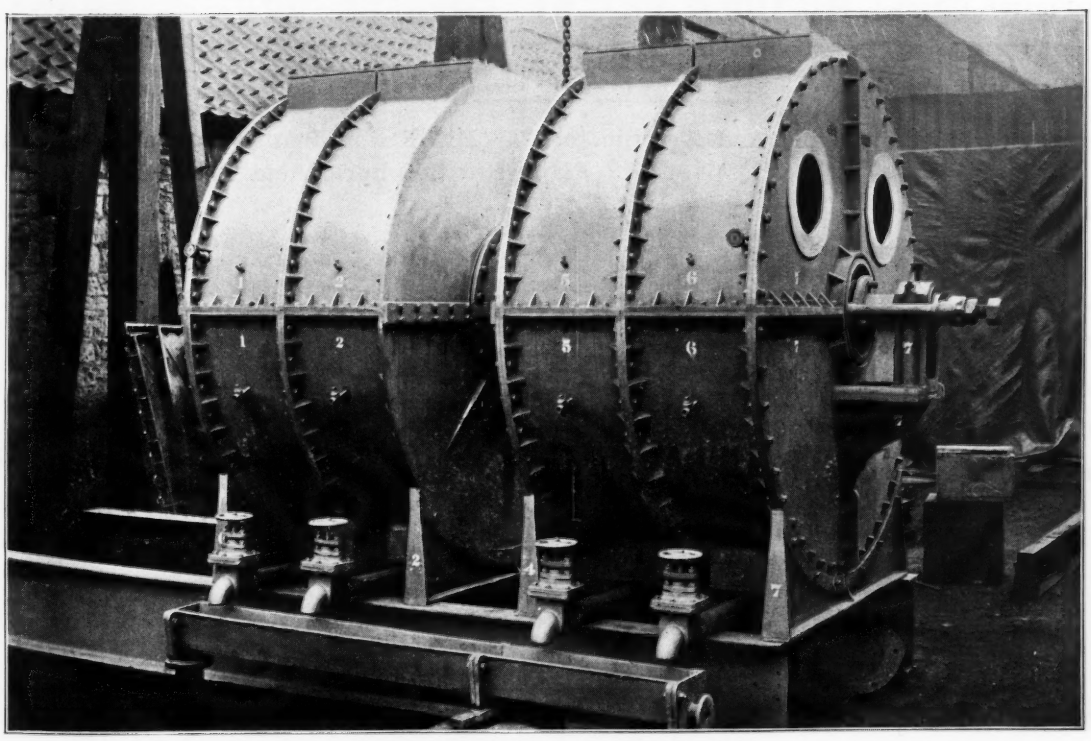
Improved Patent "Standard" Washer-Scrubbers.

Easy access to Bearings and Interior.

MAXIMUM STRENGTH LIQUOR PRODUCED. MINIMUM WATER SUPPLY REQUIRED.



Complete Extraction of Ammonia and large proportion of H_2S & CO_2.



For Extraction of Cyanide and Naphthalene.

ADDRESS: PALACE CHAMBERS, BRIDGE STREET, WESTMINSTER, S.W.

"ACME" GAS COOKERS

ARE SPECIALLY ADAPTED

FOR HIRING OR INSTALLATION

PURPOSES.

HIGH IN QUALITY.

LOW IN PRICE.

Arden Hill & Co.,
Acme Works,
Birmingham.

THE CHEMICAL ENGINEERING CO.

AND

WILTON'S PATENT FURNACE CO.,

Telephone: No. 2669 AVENUE.
Telegrams: "EVAPORATOR, LONDON."

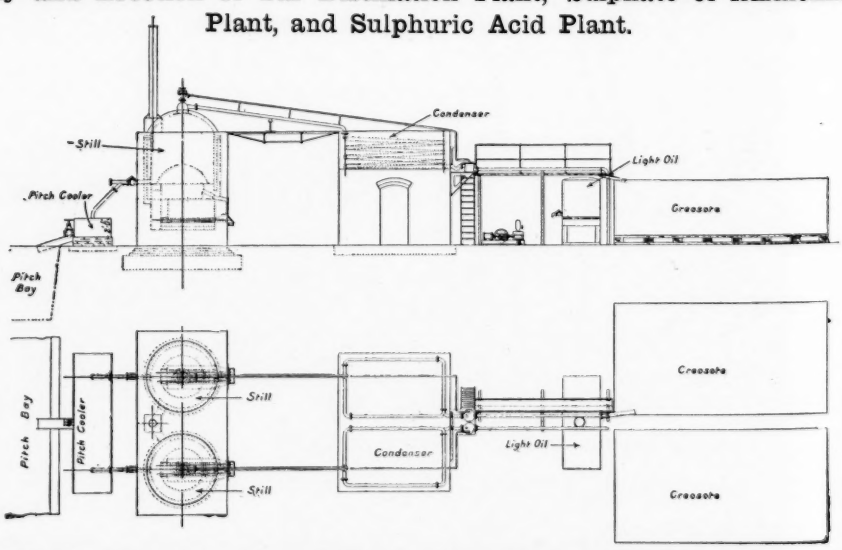
CROWN WORKS,
ABBEY LANE,
STRATFORD, E.

79, MARK LANE, E.C.

Contractors for the Supply and Erection of Tar Distillation Plant, Sulphate of Ammonia Plant, and Sulphuric Acid Plant.

PURE BENZOL PLANT.
TOLUOL PLANT.
PYRIDENE PLANT.
SOLVENT NAPHTHA PLANT.
PURE CARBOLIC ACID PLANT.
NAPHTHALENE PLANT.
ANTHRACENE 80 per cent. PLANT.

CYANIDE.
PRUSSIATES.
BLUES.



CONVEYORS and ELEVATORS SPECIALLY DESIGNED FOR THE ABOVE PRODUCTS

Wilton's Patent Neutralizing Apparatus for the Waste Gases from Sulphate of Ammonia Plant.

CONTENTS.

EDITORIAL NOTES.

GAS, LIGHTING, &C.—
The Meeting of the Institution of Gas Engineers 739
Retirement of Mr. J. W. Field—and After. 739
The Opening of City Roads 740
The Sunday Gas-Testing Litigation. . . 741
Vertical Gas-Retorts—The See-Saw of the Paris Gas Question—The Cost of Relief in the Purchase of Mantles—Inferior Foreign Mantles—A Valuable Carburetted Water-Gas Plant—The Making of Municipal "Profit"—"Willey's Weekly"—The Work of the Patent Office—A Prospective Increase 741

INSTITUTION OF GAS ENGINEERS.

ANNUAL GENERAL MEETING IN LONDON—
Review of Proceedings 745
A Sketch of the Proceedings 747
General Report—
Confirmation of Minutes; Report and Accounts; Deceased Members; Awards of Premiums; Honorary Members . . 759
President's Address 761
Papers and Discussions; The Benevolent Fund; Office-Bearers and New Members 764
Place of Next Meeting; Votes of Thanks 765
The Lecture—Candles and Calories. By Professor Vivian B. Lewes, F.I.C., F.C.S. 766
Papers and Discussions—
Photometry and Testing. By Walter Grafton, F.C.S., of London 771
The Lewes Process at Tipton. By Sidney O. Stephenson, of Tipton 782
The "Selas" System of Intensified Gas Lighting both for High and Low Pressures. By F. D. Marshall, of Copenhagen 790
Later Developments in High-Pressure Lighting. By A. W. Onslow, of Woolwich 795

ESSAYS AND REVIEWS.

The Working of the Granton Inclines . . . 744
The Last Meetings of the Institute and Institution 744
Gas and Water Stock Market 804
The Present and Future of the Hastings Gas-Works. 805

TECHNICAL RECORD.

The Settle and Padfield Carbonizing Process 807
The "Rocket" Street Lamplighter . . . 809
Heating Value of Mixtures of Gases . . . 810

CORRESPONDENCE.

Gas "Arc" Lamps 810
The Retort-House Roof at Hastings . . . 810
Electricity Undertakings and Depreciation . 810
Monazite Sand. 811
Mr. Leicester Greville's Article on Gas Liquor 811

PARLIAMENTARY INTELLIGENCE.

Progress of Bills 811

LEGAL INTELLIGENCE.

The Sunday Gas-Testing Question—Injunction Granted by Justice Kekewich and Suspended by the Court of Appeal 811
Sequel to a Gas Explosion at Wrexham . . 812
The Sale of Infringing Mantles. 813
A Dublin Gas Explosion. 813
Severe Censure of an Electric Light Company 813

MISCELLANEOUS NEWS.

Gas *v.* Electricity in Paddington—Victory for Gas 813
The Welsbach Mantle Actions Guarantee Fund 813
Gas Supply of Belfast 813
Reduction in Price at Salford 814
Batley Corporation Gas Supply. 814
A Good Year at Warrington. 814

MISCELLANEOUS NEWS (*continued*)—
Workington Corporation Gas Supply . . . 814
Electric Lighting Notes 814
Southwark and Vauxhall Water Company . 815
Stock and Share List. 815
Grand Junction Water-Works Company . . 816
Sheffield Corporation Water Supply—General Manager's Annual Report. 818
Notes from Scotland 820
Current Sales of Gas Products 821
Coal Trade Reports 822
Patent Notices. 825

PARAGRAPHS.

Siloxicon—The "Oberon" Mantle—The Parisian Electric Turbine Retort Charger and Discharger 743
Wages and Profits in Coal Mining. . . . 744
Evening Star Lodge 756
The "Flicker" Photometer in the Provinces 808
Rochdale Water Supply 813
Reductions in Price 822
The Fatal Accident at Kennington Oval—Electrolysis at Leeds—Reduction in the Price of Gas at Widnes—Improved Results at Loughborough—St. Helens Gas Supply—Sales of Shares—Water-Meters in America—Margate New Water Scheme . 823
Intensified Gas Lighting in the Bury Market—Satisfactory Working at Ossett—Welsbach Incandescent Gas-Light Company, Limited—Gainsborough Gas Supply—Bury Corporation Gas Undertaking—Burgess Hill Gas Company 824
Peterborough Water Supply—Winding Up the Exmouth Water-Works Company—Metropolitan Water Board—Water Scheme for West Cumberland—Devonport Corporation and the Water-Works 825
Defective Reservoir at Teignmouth—Increased Capital for the Dorking Water Company. 826

Messrs. HUMPHREYS & GLASGOW

AND

THE UNITED GAS IMPROVEMENT CO., U.S.A.

CARBURETTED WATER-GAS PLANT

— *DOUBLE SUPERHEATER SYSTEM.* —

H. & G., LONDON **135,450,000** Cu. Ft. Daily

U. G. I. CO., U.S.A. **366,950,000** Cu. Ft. Daily

TOTAL 502,400,000 Cu. Ft. Daily

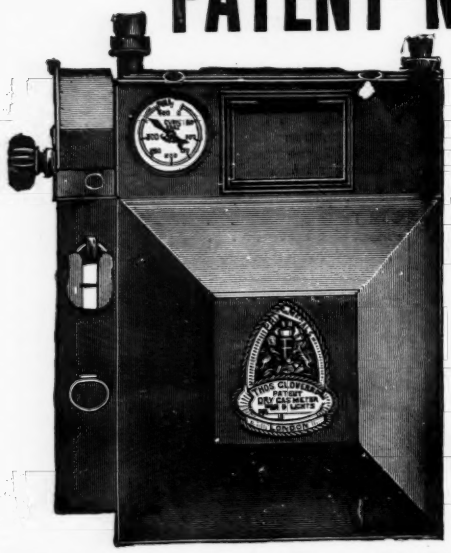
Messrs. HUMPHREYS & GLASGOW,
38, Victoria Street, London, S.W.
31, Nassau Street, New York.

THE UNITED GAS IMPROVEMENT COMPANY,
Philadelphia.

Telegrams: {"EPISTOLARY, LONDON."
"HUMGLAS, NEW YORK."

THOMAS GLOVER & CO.'S

PATENT NEW IMPROVED PREPAYMENT METER



For Pennies, Shillings, or any Coin.

Simple in Mechanism.
Positive in Results.
Price Changer *in Situ.*

GUARANTEED FOR FIVE YEARS.

Telegraphic Address: "GOTHIC, LONDON." Telephone No. 725, Holborn.

THOMAS GLOVER & CO., LTD.,

DRY GAS-METER MANUFACTURERS,

214 TO 222, ST. JOHN STREET, CLERKENWELL GREEN, LONDON, E.C.

Telegraphic Address: "GOTHIC, LONDON. Telephone No. 725 Holborn.

BRISTOL: 28, BATH STREET. *Telegraphic Address:* "GOTHIC." Telephone No. 1005.

BIRMINGHAM: 57 & 58, BROAD STREET, *Telegraphic Address:* "GOTHIC."

MANCHESTER: 132 & 134, CORN EXCHANGE BUILDINGS. *Telegraphic Address:* "GOTHIC." Telephone No. 3898.

GLASGOW: 26, WEST NILE STREET. *Telegraphic Address:* "GASMAIN." Telephone No.: 6107 Royal.

PARKINSON'S

PATENT

EQUILIBRIUM GOVERNORS.

These Governors are being used at a great many Works, and all Engineers speak of them in words of unqualified praise.

FITTED WITH SIX COLUMNS and GIRDERS, WEIGHTS or WATER PRESSURE.

PARKINSON AND W. & B. COWAN, LTD., (*Parkinson Branch*),
COTTAGE LANE, CITY ROAD, LONDON. | BELL BARN ROAD, BIRMINGHAM.

JOURNAL OF GAS LIGHTING, WATER SUPPLY, &c.

EDITOR & PUBLISHER: WALTER KING. OFFICE: 11, BOLT COURT, FLEET ST., LONDON.

VOL. LXXXII., No. 2092.—TUESDAY, JUNE 16, 1903.

EDITORIAL NOTES.

The Meeting of the Institution of Gas Engineers.

THE first meeting of the new Institution of Gas Engineers has been held, and was successful surpassing expectation. The attendance was larger than was looked for by the pessimistic; and it was maintained throughout in a manner beyond praise. The papers proved to contain matter very much more attractive than the promise of their titles. This phenomenon, by the way, is not a rarity; and the circumstance is one to be borne in mind with regard to all similar occasions. Discussibility is one of the chief merits which a paper for reading at a technical gathering can possess; and it is happily one that can never be predicted from the name the author chooses to give his paper. It is therefore necessary to attend the meeting in order to ascertain whether it is worth while to do so. Most of the papers read at this meeting—and they were all read, which is another good point—gave rise to animated discussions, characterized, without exception, by the utmost friendliness of tone. The experiment of holding morning meetings only, which was repeated on this occasion, broke down on the last day, as it always does. On the whole, the balance of advantage seems to be in favour of making (say) the first day a full one, even when the papers are not numerous, and so breaking well into the bulk of the business as quickly as possible.

The success of the gathering was largely due to the personal character of the President, Mr. Andrew Dougall, who was an ideal selection for the office at this special juncture. His fairness and kindliness of disposition were known to every member present; for, in consequence of the force of circumstances, Mr. Dougall has played a leading part in the domestic politics of the gas engineering profession of these kingdoms for at least ten years, off and on—generally "on." In this way his name has been as familiar in the mouths of his colleagues as that of Mr. James W. Helps himself—prince of Honorary Secretaries; and the pair have at last been rewarded by finding themselves at the head of what every true Briton must regard as the finest team of gas technicians in the world. If it is not, it ought to be, having regard to the history, the importance, and the usefulness of the industry represented. A sense of this consideration obviously weighed heavily upon the President, and guided his address to the members into the particular channel which it actually followed, to the general content. All the President talked about, in effect, was how to make the new organization not only worthy of the loyal support of the members, but also of engaging for itself in the future the patronage of gas proprietors, public and private. To this end Mr. Dougall offered a number and variety of suggestions for organized action for purposes other than the collection and discussion of papers, as to which it is enough to say that there appears to be no adequate reason why some should not be put into operation at an early date. The unusual spectacle was offered of the meeting spending an hour in debating the chief heads of the President's Address, which thus fulfilled the office of an extra paper on policy; and the time was very well occupied.

The social side of the meeting was extremely well arranged. A *conversazione* took the place of every other formal evening function, and constituted another triumph for the President—participated in for this occasion by Mrs. Dougall. The excursion to Eastbourne, while open to the observation applying to most affairs of the kind of making a very long day, gave the President-Elect, Mr. H. E. Jones, a chance of contributing his personal influence to the sum of those things that rendered the day pleasant to remember. It is right to say that the meeting, from beginning to end, followed a high rule of purpose and endeavour; and that the abuses of a past day were wholly absent. All the same, it will probably be wise to hold the annual meetings for the immediate future in London, for several good and sufficient reasons which will occur to everybody. Among others, a certain amount of social pleasure is legitimately looked for in connection with these annual gatherings of friends who do not meet at any other time; and the very numbers which attest the popularity of the new Institution render country assemblies and country entertainment impossible.

At the same time, of course, a close and living connection of the Institution with every part of the kingdom is a thing to be aimed at, as a prime condition of enduring usefulness and success. This could be ensured by a well-devised plan for linking the technical work of the profession in the Provinces with head-quarters. The idea is an old one; but it has now a better chance of coming to something by way of result than has hitherto been possible. The best prospects of such a realization of a familiar aspiration would seem to lie in keeping the connection one of strictly limited nature, for mutual advantage, and allowing full liberty for every case to be dealt with in its own way. There need not be any rigid uniformity in the arrangement, which, indeed, would probably defeat its own object. The matter lies open for consideration; and it is one to which the Committees of all District Associations will certainly have their attention drawn in due course. Unity promotes unity; and the fact of the Institution being a united body will enable it to approach with the best of credentials the independent organizations referred to in the President's programme. Yet in their case the disadvantages of independent existence are not the same as those that hampered the usefulness of the defunct national societies, inasmuch as territorial separation is of the very essence of their serviceableness to their own members.

After all is said, and regardless of the extent to which the President's pious aspirations may prove to be realizable, it must be repeated that the new Institution has made an excellent start, so that already the tale of ancient discords is remembered only as an "old, unhappy, far-off" thing which belongs to another stage of existence. In order that the life of the new departure may be preserved, it will be necessary for the Council to early consider the provision of sufficiently interesting and important papers for the future meetings—as a matter of fact, at least one paper by a prominent member is already definitely promised for next year.

Retirement of Mr. J. W. Field—and After.

THE announcement we make to-day, by authority, of the retirement of Mr. John W. Field from the joint offices of Secretary and General Manager of the Gaslight and Coke Company, will be regarded by all whom it may concern as a piece of news of first-class importance. And it concerns a good many; for the chief executive officer of the largest gas undertaking in the kingdom is, and must be, a personage of vast influence and commanding position in the world of affairs. It is due to Mr. Field to record the fact that his high personal character for integrity, and only too concentrated devotion to the interests of the Company he has served so faithfully and so long, are as widely recognized as his name is known. All who hear the news of his retirement will sincerely regret the cause—failure of health, attributable entirely to overwork—and will heartily hope that relief from the pressure of the responsible and onerous duties of his eminent position will bring a restoration of strength to so good a worker, who, if he had the reputation of being a hard man in his interpretation of whatever was due to the Company, was hardest of all to himself. There was not another man in the service of the Company, high or low, who worked harder than the head of the staff—few, indeed, anything like so hard. It is easy to say now that Mr. Field overdid it. Being the man he was, he could not do otherwise; but it was a mistake, as well as a pity, all the same. All men have the defects of their qualities. Such tremendous workers as Mr. Field, commonly fall into the error of overtaxing themselves by attempting to keep too much in their own hands. They are obsessed by the idea conveyed in the "saw," that whosoever wants a thing well done must do it for himself. This is all very well, when it is not carried to an extreme. By common repute,

Mr. Field did carry to extremes the personal supervision of the enormous mass of every-day detail that goes to compose the business of such an undertaking as that of the Gaslight and Coke Company. He could not, or would not, practise devolution of responsibility and power of decision to the extent necessary, if the conduct of huge affairs is to be humanly possible. The consequence is that he wore himself out in ten years of supreme charge, and has now to give it all up to others.

The retirement of Mr. Field at this particular juncture, when the internal polity of the Company is being so extensively rearranged, has, of course, no connection with the carrying out of these reforms. It is in this regard purely accidental. But nevertheless it is quite possible that it may have the effect of starting further changes which might otherwise have been delayed indefinitely. We do not shrink from asserting that the opportunity is a good one for some of the oldest occupants of seats on the Board to consider whether they could not better serve the interests of the Company by giving place to younger men. Several of these gentlemen were comparatively young when they first of all assumed office; and they might bethink themselves of the difference between then and the present. The new General Manager, Mr. Watson, and the new Secretary, Mr. Rayner, are both young men; and, while wishing them God-speed on their hard and toilsome way, we also wish they could have a fresher Board to work under. A new chapter is opening in the history of the Company; and considerable changes must be effected in the methods of transacting the affairs of the undertaking. It will be no easy task to follow Mr. Field. He had no such difficulty in taking the reins from Mr. John Orwell Phillips, because, as a matter of fact, he had done the work for some time before Mr. Phillips finally retired. There has not been any such power behind his own throne. And, besides, when Mr. Phillips retired, it was considered to be practically impossible to divide the offices of Secretary and General Manager, which has now been decided upon. This rearrangement alone will entail a good deal of directorial deliberation. There ought to be some new Directors, unbroken to the ways of the late General Manager; and they ought to be business men, not fed with the official red-tape. The reforming hand of Mr. Corbet Woodall is visible in the recent staff appointments; but he cannot be everywhere nor do everything that is still highly desirable to be effected in the interest of the Company. As an Engineer, his chief preoccupation must be the works of the Company. If he had a colleague or two on the Board as adept in business matters as he is in technical affairs, it would be infinitely to the advantage of the undertaking.

The period of office of Mr. Field has been a momentous one. He saw the Company through many vicissitudes; and the part he played in regard to these experiences, though much canvassed, was never fully disclosed. After ten years, the quality of his management of the Company remains as much a question for speculation as it was in 1893. We cannot go through the records of the undertaking for this period; nor would it be of much service to any present or future interest to do so. Whatever the actual amount of Mr. Field's responsibility for anything that has happened to the undertaking during his dictatorship, there will be no successor to carry on his methods. A large measure of devolution is called for; and henceforward the merits of the principle of the amalgamation of the Gas Companies north of the Thames will be tested under totally different personal conditions. This is the main consideration suggested by Mr. Field's retirement. For the time being, no one man in the Company's service will bear the undivided, unnecessarily concentrated responsibility that partly descended upon, and in part was really usurped by the late Secretary and General Manager. The change will be well worth trying.

Whether eventually it will appear desirable to have greater concentration of administrative power and responsibility upon the Board, remains to be seen. This, be it observed, is another question altogether from that of the centralization or the devolution of executive power and responsibility. The system of which Mr. Field was, and probably will remain, the last exponent, was that of executive centralization. It is no reflection upon him as an individual to say that he failed to justify it, because no one man could have succeeded in the endeavour he made. A certain degree of executive centralization was imperative consequent on the extensive amalgamations that were carried through, for good or for evil, by Mr. Phillips. For a time, every executive decision had to be reposed upon one head. Mistakes would just then have been less mischievous than divided authority. Mr. Phillips used to claim that he saved £50,000 a year in this way on one amalgamation alone. But the time came for an extension of executive responsibility, subject to a common interest; and this step was never taken at the Horseferry Road under Mr. Phillips or his lieutenant and successor. It will be necessary to begin the process now—late, it is true, but perhaps not altogether too late. The worst of it is, so many "new brooms" are required to sweep up long-standing messes of this kind, because men who have grown old in leading-strings cannot be trusted all at once, if ever, to go alone. It is the weakness of despotisms to have nobody to replace the autocrat when he is removed; and this, of course, is irrespective of his quality in government. If the Horseferry Road system for the past two reigns—that is to say, for a lifetime—has not been an oligarchy, repute has sadly misrepresented it. The change in this respect will have its own dangers; but the proprietors and the public who are alike interested in the bringing of all questions of the kind to a happy issue, have the one great and inestimable guarantee against the worst results, that all the men who will face the future under new constitutional forms are honourable, upright, and absolutely devoted to their duty. Where this personal integrity exists, as it does here, any experiments in government that may appear to be worth trying cannot produce irreparable mischief. The question of ability, of course, remains to be answered by experience; but there is no reason to suppose that there are not as able men in the Company's service as could be found outside. A whole string of young men have now their chance of a lifetime for earning distinction in the employment of the Company; and there is no call to speak of failure in connection with their names, until they have all had a fair trial.

The Opening of City Roads.

The Clerk of the London County Council—Mr. G. Laurence Gomme—has been instructing the Royal Commission on London Street Traffic as to the views entertained by the Council concerning the subject of main-laying in the public roads. He explained that the Council have promoted Bills in Parliament, without any success, which would have had the effect of making the Council the highway authority for the whole of the Metropolitan area outside the City. This is a way of the Council, which would be made much plainer if Parliament would only be so kind as to pass a short Act to enable the Council to do anything and everything they please. The aspirations of this modest body really are as simple as the proposal of the Polite Lunatic in "The Belle of New York." They only want their own way—that is all. As regards main-laying, the Council think that three months' notice should be given by anybody who desires to touch a Metropolitan street for any purpose. It is a simple proposition. Of course, it is only reasonable that mains laid in the principal streets of populous towns should be otherwise regarded than works of the same order executed in country roads. There ought to be some precise understanding among all the interests concerned in the use of the roads for any purpose, as to how their respective objects could be attained with the least possible annoyance of one another. As we have repeatedly had occasion to mention of late, this matter is one of growing importance for gas companies, in consequence of the extension of electric tramways. In the future, there is every probability that roads will be made much more expensively and elaborately than has been the practice in the past. Steel-covered motor-car and bicycle tracks are coming, as certainly as the next solar eclipse. The road works arising out of these public services will be heavy; and they will be carried out regardless of the convenience of gas companies, unless the latter agree beforehand with the local highway authorities. It is very clear that the owners of mains and pipes cannot stand in the way of public road improvements; but this is no reason why their interests should be sacrificed whenever changes are brought about. The great objection to the unlimited extension of the powers of the London County Council over the public roads proceeds from the peculiar bent of this body, in putting wheels within wheels. They make a practice of bargaining with the interests affected by their proceedings of any kind, and make even their statutory consents conditional. They think it smart,

apparently, to attach all manner of conditions to whatever grants it is within their power to make or to withhold. The smartness in question is of the schoolboy type; but, such as it is, it is mightily a favour at Spring Gardens.

The Sunday Gas-Testing Litigation.

THE opinion of the law expressed by a certain immortal representative of Municipalism in earlier days is too familiar to require restatement. It constantly recurs to mind, however, in the course of reading reports of cases in the Courts. The present state of the litigation between the London County Council and the South Metropolitan Gas Company over the Sunday gas-testing question is an example in point. Though the first round in this legal battle has gone against the Company, it is scarcely necessary to observe that they are not materially affected by such a trifling consideration as a Judge's declaration. As a matter of fact, the Company still keep the testing-stations locked on Sundays, pending their appeal. Equally of course, the County Council could not wait for the result of the appeal, but insisted on getting access to the stations. Accordingly, they last week applied to Mr. Justice Kekewich for an injunction to give effect to Mr. Justice Joyce's recent declaration. The Judge, while regretting the precipitate hurry of the Council, did not, however, see his way to refuse the injunction asked for; and therefore he granted it. The Company immediately appealed, and the following day the Appeal Court suspended the injunction until the hearing of the appeal in the action, with costs in any event. The plea of urgency advanced by the County Council brought down upon them a scathing reminder by one of the Lords Justices of their own way of looking at a legal decision which they did not happen to like. It is this blowing of hot and cold on the part of local authorities which gets them into disfavour. There cannot, in the present instance, be any such need for hurry as would warrant the Council in spending the ratepayers' money on interim applications; yet they spend it as though the matter were one of life or death.

Vertical Gas-Retorts.

The idea of using vertical retorts for the distillation of coal in the manufacture of gas is, of course, by no means new; but it is one to which just now considerable attention is once again being devoted. In last week's "JOURNAL" was reproduced the patent specification of an invention by Dr. Julius Bueb having for its object to provide means whereby the great advantage of vertical retorts is secured, and their disadvantages practically done away with. Dr. Bueb remarks that gasification in vertical retorts was practised in the early days of gas lighting; but it was given up on account of its disadvantages. One of the greatest of these was the fact that the gas left the reforts only at the upper part, and that produced in the lower part had to pass through the whole of the incandescent charge before it could escape—thereby, of course, suffering seriously in illuminating value. This defect Dr. Bueb proposes to obviate (as described in his patent) by providing outlets practically throughout the length of the retort, opening into a collecting passage out of range of direct action of the fire, so that the gas can escape without having to traverse the red-hot charge. In to-day's issue, we are able to describe an English patent taken out by Messrs. Settle and Padfield, also having for one of its objects the permitting of the distillation of coal in vertical retorts without the resultant gases being obliged to pass through a mass of red-hot coke. It will, however, be seen at once that the means suggested by the two patents for attaining this end are of a quite dissimilar character. Dr. Bueb charges in bulk in a vertical retort; and his invention consists, practically, in placing the ascension-pipes at the side of the retort. Messrs. Settle and Padfield, on the other hand, claim a method of feeding vertical retorts whereby the coal is introduced into the retort in small quantities at regular short intervals, thus having a continuous layer of coal in the process of carbonization on the top. There are, as will be seen from the specification, other points in connection with the invention; and one matter which may be referred to is the facility it provides for using up a waste product in the shape of small coal, which is now practically a drug in the market. It is safe to say that the appearance of these two specifications will greatly stimulate the interest which is manifesting itself in the question of vertical retorts; and gas engineers will be anxious to learn further particulars in regard to the arrangements. These will, of course, be forthcoming in good time, and will enable an opinion to be formed as to the merits of the inventions. Our object in penning this paragraph is not to prejudge the matter in any way whatever, but merely to draw the attention of readers to the proposals lest (among the press of other matter) they should unfortunately be overlooked. This much it is no more than our duty to do; for the specifications suggest a departure from present-day practice of a most important and far-reaching character.

The See-Saw of the Paris Gas Question.

It is pretty generally acknowledged that Paris is a city of surprises—that the "*Vive*" of to-day may be the "*A bas*" of to-morrow. One must not be astonished, therefore, to find that when a public question is under discussion—when it is, so to speak, in the balance—it is subject to a kind of see-saw movement which is not a little perplexing to those who are following the course of events. This is very much the case with the gas question. As an esteemed correspondent in the city, writing on the subject a few weeks since, remarked, decisions come to one week may be upset the next. Not long ago, it seemed to be tolerably certain that the Americans would obtain the new concession for the supply of gas; then the Prefect of the Seine had a word or two to say on the matter, which turned the scale against them. In fact, the language of M. de Selves was so unmistakably antagonistic, that they did not appear to have the ghost of a chance. Notwithstanding the definite pronouncement of this important official, however, the reporters of the Sub-Committee of the Gas Committee of the Municipal Council last Tuesday caused to be distributed a report formally approving of the American scheme. Great was the surprise at the Hôtel de Ville, where everybody was expecting to receive a kind of general project or specification which would be open to all the parties interested in the competition, rather than a series of conclusions favouring strangers to the detriment of the national treasury. The reporter (M. Chautard) and his colleagues, however, did not think proper to submit such a project. Without adducing any fresh arguments, or even refuting the serious objections raised by the Prefect of the Seine and others, they simply repeated the statement that, as the Americans would guarantee, even in case of loss, an annual payment to the City of 17 million francs, there was justification for handing over to them the most important of the Parisian industries. The report came on Thursday afternoon before the full Committee—we say "full," though, as a matter of fact, only about 20 out of the 44 members were present—when, after less than an hour's consideration, it was adopted by seven votes to six; the rest of the members abstaining from recording their opinions one way or the other. The matter now rests with the Municipal Council, who met in ordinary session yesterday; and their proceedings promise to be lively before this question is disposed of.

The Cost of Relief in the Purchase of Mantles.

After some delay, due to the clearing up of the expenses incurred, Sir George Livesey has, within the past few days, been in a position to address his final report and the statement of accounts to the guarantors of the fund which was started early in 1902 to provide the means to defend the action for infringement of the Welsbach patents against the United Chemical Company, otherwise the Guaranty Mantle Company. The intention, as explained at the time, was to ensure, by having the question fully and properly threshed out, that the state of uncertainty in which the gas industry was involved in connection with the purchase of mantles should once and for all be set at rest. What happened is now matter of history. But the result, so far as the industry is concerned, was that the fund and the personal work of its originator were the means of opening, on easy protective conditions to be complied with by either vendor or buyer, business in any and every mantle on the market, with the inevitable consequence that since mantles have been obtainable at lower prices than formerly. That this has been of incalculable benefit to the gas industry, no one can gainsay. Secondary advantages have been that the gas industry has since known exactly its position in relation to this matter of competing mantles, and has been emancipated from that restraint that was set upon them

by the monotonous, irritating litigation and prolific legal threatenings that seemed so deeply rooted as to be positively interminable. In the last paragraph of his report, Sir George says that "all the gas companies and corporations supplying gas who have taken part in this effort have the satisfaction of knowing that good work has been done not only for themselves, but for the gas industry and gas consumers generally throughout the Kingdom." But, turning to the accounts, it is rather astonishing to find that comparatively few gas companies and corporations shared in the good work by guaranteeing contributions, though all have reaped so much advantage. In all, there were only 54 undertakings who promised support by amounts of £10 and above, and a few under that figure made up a sum among them of £24. However, the total amount guaranteed was £6849; and of this the South Metropolitan Company made themselves responsible for nearly one-third. The Commercial, Newcastle, Sheffield, Crystal Palace District, West Ham, Dublin, Bolton, Cardiff, Birkenhead, Coventry, Huddersfield, Wandsworth and Putney, Salford, Plymouth, and Southampton concerns were other generous subscribers. Their amounts, and the smaller guarantees, together with the actual sums to be paid, will be found set out on p. 813. It is only right that the names of those undertakings who supported Sir George should be known. The total amount guaranteed was £6849, and of this £2649 was spent, or about 38 per cent. The particulars of the manner in which the latter sum was expended are entirely a matter for the guarantors; and full information is given them in the accounts. While one item has caused Sir George some dissatisfaction, it must be said that the gain resulting from the action taken exceeds in worth to the gas industry far more than this expenditure of under £3000.

Inferior Foreign Mantles.

There is one paragraph in Sir George Livesey's report to the guarantors of the above-mentioned fund to which we desire to give prominence; and this cannot be done better than by quoting it as it stands. It deals, in the first place, with a matter to which the "JOURNAL" has on more than one occasion called attention; and it is a satisfaction to find Sir George using his influence in the same direction. He writes: "I take this opportunity of suggesting that all gas undertakings should set their faces against the use of inferior foreign mantles, of which large quantities are brought into this country. There are two reasons for this suggestion: First, the use of inferior mantles does great injury to the gas industry by bringing the incandescent system of lighting into disrepute; and, secondly, because any tolerance of this surreptitious trade is not fair to the genuine mantle makers of either this country or abroad. I think after their reasonable action last year, the Welsbach Company and those makers, either home or foreign, acting under licence or agreement with them, should be supported; their mantles being both cheap and good. The terms are as follows: Any company or person is free to purchase, at any price that may be agreed, of the Welsbach, and all other makers working in agreement with them—the ¼d. per mantle royalty being paid by the makers. Or any gas undertaking can (although it is certainly not worth while) make mantles in this country at ¼d. royalty, or they may be purchased of foreign makers on the payment of a royalty of ½d. per mantle. A little attention to this point will, I think, be to the general advantage."

A Valuable Carburetted Water-Gas Plant.

An idea of the great advantages to be derived from the adoption of carburetted water-gas plant—at any rate, in certain circumstances—can be gathered from Mr. James Stelfox's report on the gas supply of Belfast during the past year. So long ago as 1892, when the annual output from the works was only 1143 million cubic feet, and the maximum day's consumption about 6¾ million feet, the city was frequently in desperate straits; and since then the output has risen to 1735 million cubic feet, and the maximum day's consumption to nearly 9½ million feet. During the whole of this time, however, the necessity for the acquisition of further ground and the erection of new works has been avoided by the use of carburetted water gas. The adoption of this system has entailed an outlay of some £65,000, as against an expenditure of at least £350,000 which would otherwise have been required to meet the demands. The ratepayers as well as gas consumers of Belfast have good reason to be grateful to the Gas Committee and Mr. Stelfox for having so far avoided the addition of so large an amount to the capital of the undertaking; and it is to be hoped that nothing may occur to necessitate any change in a policy which has been attended with such satisfactory results.

The Making of Municipal "Profit."

An interesting revelation of the manner in which municipal accounts are adapted to the exigencies of the situation, was made last week by Alderman Radford, the Chairman of the Plymouth Corporation Electricity Committee. In congratulating the Town Council on the gratifying condition of the electrical undertaking, he said that the net profit was £2600; but he immediately added that the Committee had not paid the whole of the capital charges. They had paid last year £4400, and this year about £5600, for the redemption of capital; but if they had raised stock for the whole of the capital expended, the sinking fund would have amounted to about £2000 more. He went on to contend that it was perfectly right that, in the case of a young undertaking, the whole of the charges for interest and sinking fund should not be borne, because a large amount of the capital was still unproductive. This argument was scouted by Mr. Page, who followed in the discussion. Mr. Page was not to be convinced that there was any profit at all in the business. What the Committee called "profit," they made by overcharging the Tramway Committee for current. The maximum commercial value of electricity for traction was, he contended, 2d. were unit; and it was being sold at other places in the country at as low as 1¼d. The Plymouth Electricity Committee had been charging 3d., and had not made their money by good management, but at the expense of the tramways. As to the sinking fund, the fact was that there was an accumulation of unauthorized capital expenditure, which amounted to about £60,000. This had been going on since 1899, and no provision had yet been made for sinking fund. Instead of profit, therefore, there was really a deficit of £1600. Besides this, there was no provision for a depreciation fund; and altogether the outlook for the ratepayer of the future was not bright. Criticism of this kind was, of course, unpleasant to the ardent supporters of the Electricity Department; and Mr. Debnam rather warmly repudiated it. In his opinion, the undertaking is being run upon "solid business lines." It was true, he admitted, that there was this unauthorized capital expenditure for which no provision had yet been made for repayment; but this was excusable, because the money had been spent in advance of immediate requirements. If Plymouth gets the Government audit with which it is threatened, it will be interesting to see what is the official view of this method of running a municipal trading concern on "solid business lines." One thing certain is that the Corporation will not be allowed to pile up capital charges by getting advances from their bankers; and still less will they be permitted to treat this money as a sort of floating debit, for the repayment of which no provision need be made.

"Willey's Weekly."

An interesting departure has been made by Messrs. Willey and Co., of Exeter, in the establishment of a newspaper for the special benefit of all who are in any way associated with the firm; and the appearance of the first number promises exceedingly well for the enterprise. In a large undertaking it is always difficult to keep the workers in the different departments in touch with one another, so as to secure a free interchange of ideas; and this fact, which was fully realized by Messrs. Willey and Co., led to the suggestion to establish a weekly journal, as a useful and practical means of general intercommunication. Each reader is invited to look upon the paper in the light of proprietor; and anyone who has anything to say, or to suggest, or to criticize, is heartily invited to put his thoughts into writing. Such a golden opportunity as is here provided for those possessing in any degree originality or inventive genius will, it may be confidently anticipated, be taken advantage of—to the benefit of both masters and men. As the firm remark: "It is ideas that are worth the most nowadays; and they are as likely to be the thoughts of a boy at a lathe or a bench as of a foreman or manager." With such encouragement as this held out, there will be no excuse for anyone to hide his light under a bushel. The certainty that any suggestion bearing upon the business of the firm will receive careful attention, should be sufficient to induce all the men to use their brains as well

as their hands in the interests of their employers—and, of course, of themselves, since the welfare of both is closely interwoven. The publication (which consists of four pages, is illustrated, and costs one penny) contains references to affairs of general engineering interest, as well as to matters of more local concern, and includes a cartoon, the opening chapter of a story, and some paragraphs "in lighter vein." We notice among the items of news the statement that in a large establishment in London a system on different lines from this has been started for the purpose of assisting the workpeople to make use of their brains. There is a large box hung on the wall in a prominent position, labelled "Ideas," with a notice underneath to the effect that any employee having an idea for the improvement of the business in any direction, or for a good advertisement of the firm's goods, is requested to write it out and drop it in the box. The contents then go before the management, and, if used, the contributors are suitably rewarded, and the suggestions taken into consideration when promotions are being made. This is a promising innovation; but we certainly think that "Willey's Weekly" has gone one better, and we wish for our contemporary the success that its purpose so richly merits.

The Work of the Patent Office.

As usual, some interesting facts are to be gathered from the report of the Comptroller-General of Patents, Designs, and Trade Marks for the year 1902, which was issued recently. One comforting fact to be gathered from it is that the inventive genius which keeps the office busy shows no signs of serious decline; the number of applications having been 28,976, as compared with 26,777 in the preceding twelve months. It is true that this figure does not establish a record, for both in 1896 and 1897 the applications numbered over 30,000; but it is a very respectable total for all that, and makes good business for the Department. The receipts from patent fees amounted to £218,371, as against £210,187 in 1901; from designs, to £3566, as against £3432; and from trade marks, to £11,984, as against £10,506. The receipts from the sale of publications (£8364) brought the total income up to £242,285, as compared with £232,331; and as the total expenditure was only £114,925, as compared with £125,040, there was a surplus of £127,361, or £20,070 more than in 1901. The sums received from payment of renewal fees in each year since the date when the present scale came into force have increased from £88,856 in 1893, to £137,945 last year. It will thus be seen that the granting of letters patent is not an unprofitable business; but that there is a good deal of hard work attached to it, will be gathered from the fact that the number of letters and correspondence forms despatched from the office during the past year exceeded 198,000, while no less than 76,000 parcels of publications were sent out. Special attention is drawn in the report to the applications received from women inventors which numbered 609, or 2·1 per cent. of the total number, which seems to prove conclusively that men have at least one extensive field of mental labour left to them in which they have no need to seriously fear the competition of the opposite sex. From an appendix which gives the total number of accepted complete specifications from 1886 to 1901 (the latest period for which figures are available), and the number of these specifications containing subject matter for each of the 146 abridgment classes to which inventions are allotted according to the official classification, it appears that those relating to air and gas engines increased from 286 in 1900 to 310 in 1901, and those dealing with gas manufacture from 91 to 141. On the other hand, there was a decrease from 44 to 41 in the number of patents connected with gas distribution; but lamps, &c., showed an increase of one—from 353 to 354.

A Prospective Increase.

Dealing with the Patents Act of last year, the Comptroller-General remarks that the effect of Section I. will ultimately be to impose on the staff of the Patent Office, in addition to their present duties, the obligation of ascertaining in the case of every application for a patent which reaches the complete stage whether the invention sought to be patented has been wholly or in part described or claimed in any prior specification, other than a provisional not followed by a complete specification, deposited pursuant to any application for a patent in the United Kingdom during the preceding fifty years. If, as the result of this official search, it appears that the invention sought to be patented has been so claimed or described, the applicant will be informed, and will have the opportunity of amending his specification so as to confine it to so much of his supposed invention as he may desire to patent in view of the specifications to which his attention has been called by the office. This section, however, will not come into operation until such date as the Board of Trade may direct; and it will apply only to applications made after that date. The Comptroller-General says that the evils which it is thus designed to meet are generally recognized. "In the United States and Germany for many years past no patent has been granted without a preliminary official search for the purpose of ascertaining whether the invention for which the patent is sought is new. There has been no similar official search in this country; and the Committee [appointed by the Board of Trade to inquire into the working of the Patents Acts] came to the conclusion, as the result of their inquiry, that the granting of invalid patents in this country is a serious evil, inasmuch as it tends to the restraint of trade and the embarrassment of honest traders. They accordingly recommended the scheme of search prescribed by the new Act, which, while not going so far as is contemplated by the Patent Laws of the United States and Germany, will, it is hoped, be of great benefit to inventors and the public, and be free from some of the objections which have been brought against the systems of official search in force in other countries." Whether or not the new Act will perform all that is expected of it, remains to be seen. Perhaps, however, some of the disillusioned "inventors" will fail to display a proper feeling of gratitude. They may argue that "where ignorance is bliss, 'tis folly to be wise.' One result, at any rate, ought to be a considerable lightening of the most difficult branch of the work which at present falls to the lot of our Law Courts.

Siloxicon.—We learn from "Nature" that a refractory material, to which this name has been given, is being manufactured on a large scale by the International Acheson Graphite Company at Niagara Falls. It contains silicon, oxygen, and carbon, and is said to give most satisfactory results as a substitute for refractory clays, magnesia, lime, and graphite, in their application to high temperatures. The product is obtained by the action of carbon on silica at a temperature of 4500 to 5000° Fahr. in the electric furnace; the quantity of carbon employed being insufficient for the complete reduction of the silica and its conversion into carbide.

The "Oberon" Mantle.—Mr. O. Berend, of No. 132, Wool Exchange, E.C., has brought to notice a mantle which he is introducing under the above mythological name. It is a mantle with a ramie base; and with ramie Mr. Berend is closely interested. Hence the extension of that interest to the completed article. The claims made for the mantle are strength and permanence of lighting power; and therefore, these qualities being proved, he points out that the mantle is particularly suitable for public lighting purposes. It is declared that the mantle does not lose more than 10 per cent. of its lighting power after 1000 hours; and in confirmation a diagram of photometrical tests, made by a responsible observer, have been shown which, with an ordinary "C" burner, commenced at 65 candles and ended at 58 candles—the deviations in the line being of small importance. Attention has also been given to the formation of the shoulder of the mantle. This is slightly domed, and is said to fit the flame precisely, and to add to the strength of the mantle itself. The latter is being made in various sizes to suit all types of burner.

The Parisian Electric Turbine Retort Charger and Discharger.—Last Tuesday the Electric Turbine Gas-Retort Charging and Discharging Company, Limited, was registered with a capital of £10,000 in £1 shares, to adopt agreements (1) with La Compagnie Parisienne d'Eclairage et de Chauffage par le Gaz, and (2) with the Whessoe Foundry Company, Limited, to acquire any patents, inventions, licences, concessions, or grants relating to the working, charging, or discharging of gas or other retorts, or to the quenching or cooling of coke, or otherwise connected with gas making, to turn the same to account, and to manufacture and deal in machines and apparatus, &c. There will be no initial public issue. The first Directors (to number not less than four nor more than six) are Messrs. F. D. Marshall, J. Ingleby, A. Stanley, E. Ledoux, H. S. Smith-Rewse, and T. Coates. In the case of Mr. F. D. Marshall or any of his successors vacating office, the vacancy may be filled by him or by his legal personal representative; in the case of Messrs. J. Ingleby, A. Stanley, E. Ledoux, or any of their successors, the Simon-Carvès Bye-Product Coke-Oven Construction and Working Company, Limited, may fill the vacancy; and in the case of Mr. H. S. Smith-Rewse or Mr. T. Coates, or their successors, the vacancy may be filled by the Whessoe Foundry Company, Limited.

WORKING OF THE GRANTON INCLINES.

Following on the report which Mr. W. R. Herring recently made to the Edinburgh and Leith Gas Commissioners as to the comparative durability of inclined and horizontal retorts at their works, a further report which he laid before them at their meeting yesterday week will be found of interest, inasmuch as it carries us on to the question of the labour costs between the old works and the new. In reading this report it must be remembered that the Granton plant embodies many novelties and quite a new set of conditions for the men; and therefore, under the circumstances, Mr. Herring is amply justified in believing that use and experience will produce even greater efficiency and further economy. This is emphasized by what appears in the last paragraph of the report. There it is seen that the work allotted to each operator in the first instance (the works were started on Oct. 20 last) absorbed about seven to seven-and-a-half hours of the eight-hour shift. But within the short space of three months, use enabled the stokers to get through their allotted task in four-and-a-half-hours. To permit this to continue would be unfair to the proved labour-lightening effects of the new plant and to the Commissioners; and therefore, as soon as the works are re-started, the proportion of work will be increased to a point sufficient to absorb six hours out of the eight-hour shift, which will be—considering that "the physical labour involved now in the operations is very considerably lessened as compared with the former methods"—a very fair rearrangement. Perhaps this forms an item in the considerations that led to the little domestic affair at Granton which was described some weeks since as a "spring clean," and about which there was at the time a good deal of speculation in engineering circles.

The figures as to the tonnage of coal carbonized in the period reported upon, and the make, will be looked at critically in conjunction with the former report; but it must be a satisfaction to Mr. Herring to be able to show that, notwithstanding the disadvantage of inexperienced men in inclined work (and some of them even strangers formerly to gas making), the make per ton of coal at Granton has topped the results at the New Street works, and that the labour involved has been reduced by 58 per cent., as compared with the year's average of former operations (half of which is represented by gas made by the aid of stoking machinery). The items comprised in the working costs are stated in the report; and they work out to 2·021d. per 1000 cubic feet of gas made, as compared with 4·9d. for exactly comparable items in the old works. These are the points on which information is to be gathered in the report, which is as follows:—

I have to report that during the period from the commencement of the operations at the Granton works on the 20th of October last to the 15th of May, the end of our financial year, the working results at the Granton works have been of a highly satisfactory character.

During that time, 82,780 tons of coal have been carbonized, and 836,232,000 cubic feet of gas made. This is equivalent to a production of 10,151 cubic feet of gas per ton of coal carbonized at the Granton works, as compared with 10,123 cubic feet of gas per ton of coal carbonized at the New Street works during the same period—both figures representing the gas corrected to standard temperature and pressure.

For the first start of such a large new works, where everything had to be tested, and where many novel features have been introduced, I consider this highly satisfactory, and have no doubt that the results will improve as the men become better acquainted with the work they are now called upon to do.

The working costs are also satisfactory. Notwithstanding the fact that many of the men were quite new to gas-making operations, and all of them strangers to the new methods employed at the Granton works, the labour involved has been reduced by 58 per cent. as compared with the year's average of your former operations, half of which is represented by gas made with the aid of stoking machinery, coal-breakers, elevators, &c.

The items comprised in the above comparison include the following: All of the foremen; coal discharging, breaking, elevating, and conveying; attendance at the coal-bunkers; the charging and drawing of the retorts; pipe jumping, cleaning, and greasing plant; furnacemen and ashmen; the men attending the hydraulic pumps, the gas-exhausters, the washer-scrubbers, and the cyanide scrubbers; the boilermen and syphonmen; and the attendants at the hot-coke handling plant, including the loading of coke into waggons, these items costing 2·021d. per 1000 cubic feet of gas made, as compared with 4·9d. per 1000 cubic feet of gas made for exactly comparable items in the old works.

The work allotted to each operator in the new works, in the first instance, absorbed about 7 to 7½ hours of their eight-hour shift. By about January, however, the actual duration of physical labour on the part of the stokers averaged four-and-a-half hours. So soon as the new works are re-started, the men will be put upon their full work, absorbing about six hours of their eight-hour shift; a proportion which I think is fair, bearing in mind the fact that the physical labour involved now in the operations is very considerably lessened as compared with the former methods.

The report establishes the improvement which Mr. Herring long since advised the Commissioners would result, in comparison with the then existing works, from the adoption of the Granton scheme. It would be of interest to know how the amount of work first allotted to the men at Granton compared with that then being performed at the other works with horizontal retorts and stoking machinery. The men being new at the work, Mr. Herring may have been lenient in his prescription as to the quantity to be performed.

THE LAST MEETINGS OF THE INSTITUTE AND INSTITUTION.

The last meetings that will be called of members of the two old Societies were held at the Institution of Mechanical Engineers on the day preceding the first annual meeting of the new Institution. They were convened by the Liquidators—of the Institution, Mr. James W. Helps; and of the Institute, Mr. Andrew Dougall. The objects of the meetings were to receive the Liquidators' reports, showing how the winding up had been conducted and the property disposed of, to pass resolutions as to the disposal of the books, accounts, and other documents of the two Societies, and to discharge the Liquidators. At both, there was some little difficulty in forming a quorum; but eventually success attended the efforts.

At the meeting of the Institution, Mr. Helps presided. Having presented the accounts, Mr. G. C. Trewby put the natural question as to what had become of the balance. The Liquidator stated that the balance, amounting to £109 13s. 2d., had been handed over to the new Institution. This information was supplemented by Mr. H. E. Jones, who stated that there was also about £50 of stock, which, as part of the assets, was transferred to the joint undertaking. It was intimated by the Chairman that the assets of the Gas Institute were about £1400. Moved by Mr. Jones, and seconded by Mr. Trewby, the first resolution was passed—"That the accounts submitted to this meeting, showing the manner in which the winding up of the Institution has been conducted and its property disposed of, be and are hereby approved." On the proposition of Mr. Charles Hunt, seconded by Mr. S. Meunier, the following resolution was also agreed to: "That the Liquidator be, and he is hereby, discharged from his office, and that the books, accounts, and other documents of the Institution now in the possession of the Liquidator be handed by him to the Institution of Gas Engineers, incorporated in 1902, and the receipt of the Secretary of the said Institution shall be a good discharge to such Liquidator." An expression of the thanks of the members to the Liquidator for his services succeeded; the motion being made by Dr. Harold G. Colman, and seconded by Mr. Meunier. The Liquidator acknowledged the vote, and stated how thankful he was that the efforts in the direction of amalgamation had been crowned with success. This ended the proceedings.

A similar meeting of the Institute was subsequently held, at which the Liquidator (Mr. Andrew Dougall) reported the completion of all formalities; and, on the motion of Mr. S. W. Durkin, seconded by Mr. Robert Porter, the accounts were approved—the resolution, with the conversion of the title, being precisely the same as the one passed at the meeting of the Institution. The second resolution was also similar; and it was agreed to, on the motion of Mr. Porter, seconded by Mr. W. W. Hutchinson. Recognition of the services of the Liquidator was made on the proposition of Mr. J. Carter, seconded by Mr. James Keen, of Wigan. The latter gentleman spoke of the pleasant connection he had had with the Institute, and was sorry that he was not permitted to be a member of the new Institution. Mr. Hutchinson and Mr. D. Irving supported the resolution, which was carried. The acknowledgment of the Liquidator concluded the proceedings.

Wages and Profits in Coal Mining.—A return relating to this subject has been published giving statistics for the last seventeen years of the output and price of coal, the number of people employed in coal-mining, and other matters; but it is specially intended to supply estimates of the expenditure on wages and the profits of owners. The computed expenditure on wages (assuming 50 weeks' full employment for each person) was in 1902 £61,653,000, against £64,001,000 in 1901; the decennial average so spent was £49,382,000. The computed amount remaining for expenses other than wages, and for coalowners' profits, was £32,466,000 in 1902, against £38,483,000; the decennial average of this amount was £23,670,000. The average price of coal per ton at the pit's mouth last year was 8s. 2·84d., against 9·429d. in 1901 and 10s. 9·66d. in 1900. The output was 227,085 tons in 1902, against 219,037 tons in 1901. The average rate of wages per week in the United Kingdom was 30s. 4d. in 1902, against 32s. 6d. in 1901. The highest rate was 33s. 3d., against 35s. 6d. in 1901.

THE

INSTITUTION OF GAS ENGINEERS.

PROCEEDINGS AT THE FIRST ANNUAL GENERAL MEETING.

HELD AT THE

INSTITUTION OF MECHANICAL ENGINEERS, WESTMINSTER, S.W.

JUNE 9TH, 10TH, AND 11TH, 1903.

Mr. ANDREW DOUGALL, President, in the Chair.

REVIEW OF PROCEEDINGS.

IT was a bright morning when the members of the new Institution of Gas Engineers met for the first time under the new dispensation of unity and concord, at the handsome place of assembly courteously opened to them by the Institution of Mechanical Engineers. There was a grateful sense of fitness in the choice of a fresh meeting-place for the renewed professional organization of the British gas industry. Let it be said at once, that the fair promise of the opening was amply borne out by the week's proceedings; for never was a better-attended or more harmonious convention of followers of the gas profession placed to the record of any earlier organization. All was perfect, as it turned out; and the Institution made its start in the technical world under the happiest of auguries.

The hall of the "Mechanicals" is one of the latest additions to the accommodation to be found in London for the purposes of such gatherings as those of the Institution of Gas Engineers; and though, unhappily, the skill of the architect has not been equal to the task of ventilating the interior without draughts, it proved in size and seating arrangements to be well suited to the occasion.

The President, Mr. Andrew Dougall, took the chair, supported by a very representative group of members of the profession, with a creditable degree of punctuality; and the proceedings immediately became interesting. Mr. Dugald Clerk was called to receive the President's Medal and First Premium for his Gas Institute paper of last year; and, after expressing his acknowledgments of the honour, left the cheque in the hands of the Council, to be eventually bestowed upon the Benevolent Fund. The other premium takers were Mr. J. P. Leather and Mr. R. G. Shadbolt.

Next came the nomination of the first selection of Honorary Members, whose names have been reported; and these were submitted for election *en bloc*. This was eventually done unanimously. The only recipients of the distinction present at the time were Sir George Livesey and Professor Vivian B. Lewes, both of whom fittingly acknowledged the gratification they felt at this recognition of their services to the industry. Mr. Hepworth took occasion on Thursday to acknowledge the honour conferred upon him. The President's Address followed immediately after this pleasant incident.

Perhaps at no previous meeting of the kind has the address of the President taken so important a place in the programme. This was almost wholly the effect of circumstances. Whosoever had happened to occupy the presidential chair on the occasion of the first meeting of a reunited assembly of British gas engineers and managers, the peculiar degree and quality of expectancy with which the customary Inaugural Address was awaited would have been largely the same. The principal topic of the address was prescribed by the event; and no President could have hoped to arouse much interest in his official utterances, if he had attempted to ignore entirely the special requirements of the occasion. This particular necessity, like all subjects of overpowering interest which fill men's minds for the time being, brought its own difficulty for the man who was expected to discourse upon it to the general satisfaction. Irksome and painful as it may be, and usually is, to select the subject-matter for a composition of the order of a Presidential Address, it is much harder to deal with a topic that is not merely forced upon one, but which cannot by any conceivable possibility be either avoided altogether, or be touched upon lightly and indifferently. When, in addition to this attribute of inevitableness, the subject is also one that has already been threshed and winnowed out to the last particle of living interest, so that it is as stale as it is important, the task of vivifying it once more becomes one to daunt the most resourceful orator. That Mr. Dougall succeeded in performing this part of his duty to the supreme content, and even the admiration, of his hearers, is something to be placed to the credit of his personal character as well as to his accomplishment in rhetoric. The high esteem in which Mr. Dougall is held by his professional brethren predisposed his auditory to receive sympathetically whatever he might have to say concerning a matter that had notoriously been ordered in its course largely by himself; and the manner in which he presented his observations and aspirations pleasingly revealed the resources of a statesmanship which, so far from having been spent in the labours of the past, is quite equal to the prospective demands of the future of the Institution. No member of the profession who might have been called to occupy the chair of the new Institution could have done better in this respect than did Mr. Dougall; few would have acquitted themselves so tactfully and well.

The patent fact with which the President had to deal was that of the restored unity of the profession. The consideration that immediately springs from it is, how to make the fullest and best use of the union, which can only be strength according to the employments that may be properly and hopefully found for it. The only way to place beyond the reach of regrets the union that has been so happily brought about, is to set it to some useful purpose otherwise unattainable. If unity is to be more than an idle word, as the President pointed out, it must also imply concentration of effort. The new life of the Institution has been too brief as yet to permit of anything like a scheme or plan of action for the future being put forward in the shape of an official suggestion. The Council have had their hands so full of constitutional work, that nothing could be done in the nature of a propaganda. Yet, as the President fully admits, the scope and character of the work of the Institution as a whole in the future must soon engage the most earnest attention of the members. It is very clear that the original idea of a professional society of British gas engineers and managers, as being an organization for the collection, almost at random, of papers to be read and discussed at an annual meeting, with some little attraction of a social and recreative nature thrown in, has become inadequate. More co-ordination is required to produce some result worth the support of the money and time of the members generally. There are several plans of activity exemplified by the proceedings of other and similarly constituted bodies; and it will not be time wasted for the first year of the new Institution to be occupied with an inquiry, by a small Committee, into the working of these arrangements.

The first definite suggestion of the kind mentioned by the President was the familiar and obvious one of affiliating the District Associations to what, with a fine obliviousness of origins, he styled the "parent" Institution. This plan, it appears, has been proposed by "more than one member;" which can easily be believed. The next question that arises, upon such a suggestion, is: What then? If the District Associations are willing to adopt the Institution *in loco parentis*, well and good; but in this event several consequential points of membership, procedure, and so forth, are necessarily involved. The proposal is not one to be treated with applications of cold water; but it is just the sort of vague indication that people are apt to throw out without previous thought. The time and the occasion have come, however, for the disposal of this particular question. After what the President said on this head, it is for the District Associations to table the matter at the first convenient opportunity, in order that their members may make such response as may seem good to them to the amicable overtures of Mr. Dougall. The advance must come from their side, especially since they have the assurance that the Council of the Institution are sympathetically disposed towards the idea of a closer union. For example, it is not long since one District Association joined itself to a neighbour, for what appeared to be good and sufficient reasons. Now, it appears, the alternative would be open to join the Institution instead, as a Local Section. The choice of courses must depend upon a comparison of advantages and

drawbacks. Also, there must be a balance of advantage for the contracting parties. Are Local Sections to be formed for the good of the Institution or for their own, or both? These are questions that call for answers, not vaguely, nor as topics in the air, but with reference to real business.

This mention of "real business," in a way, points to what has, in the past which everybody hopes is dead, unquestionably been a weakness of the predecessors of the present Institution. There has been too much playing at organized work, and not enough real business. Just for an instance, recalled here for the sake of the illustration, and not with the smallest desire to blame anybody for the result: At one particular meeting, the announcement was made, with a degree of solemnity suited to the gravity of the subject, that an arrangement had been entered into for securing the effective action of the Association in the parliamentary field. Nothing came of it. Now the President proposes that the task thus begun, and dropped without a word of explanation or protest, should be taken up again. If so, it must be entered into with a very different spirit. The same observation applies to the work of research, once attempted, and then abandoned for no published reason. A new departure was suggested by the President in regard to the intervention of the Institution in supplying technical instruction. No one who has the welfare of the industry at heart can fail to perceive the want that exists of authoritative instruction in its true principles and their practice. As the President remarked, there is something about the teaching of the "subject" of gas manufacture in "classes" which does not answer to the real requirements of the industry. One has heard of certificates being earned by youths of the pupil-teacher type, whose acquaintanceship with a gas-works was of the slightest. On the other hand, much of the so-called instruction offered to gas engineering students has hitherto been of a distinctly inferior quality. The reason is, of course, that the right men to supervise it—the leaders of the industry—have not had anything to do with it. If the Institution can ever successfully organize such a teaching department as the American Gaslight Association has succeeded in carrying on, it will only be by dint of following just the same principles—namely, engaging the interest and services of the best men available for the duty. The truly British notion that anybody who knows a little is competent to teach those who know nothing, should be exploded; but, unfortunately, it appears to be still held by many who might be expected to know better.

With this suggestion for the undertaking of technical teaching, the President coupled another, having for its object the encouragement of inventions by foremen and leading workmen in gas-works. One scarcely likes to hint that a gentleman of the name of Dougall can have fallen into an unpatriotic error in ascribing to a foreign source the origin of such an idea; but, really, it is only fair to the eminent Scottish shipbuilding firm of Denny, of Dumbarton, to state that they had a system of rewarding meritorious inventions originating with their workpeople before the Americans ever thought of advertising their own proceedings in this regard. It has been considered in certain quarters that the celebrated Scottish firm in question are pretty good at making known their excellences; but evidently they have something to learn in this respect from their American rivals, who could much more easily reach an appreciative observer in Tunbridge Wells. Here let us remark that the usual obstacle in the way of procuring the suggestions of workmen for the improvement of their own working methods, consists in the customary indifference of the men to the interest of their employer. Nor are mechanics, as a rule, of an inventive turn—except in respect to subjects that have no relation to their ordinary work, and are in the nature of a recreation. There are exceptions, of course, and these deserve every encouragement. On the whole, so far as the interest of the employer is engaged, the best results will probably be secured by rewarding foreman and workpeople for fruitful suggestions relating to their own particular jobs. A man may not be inventive; but if it is made worth his while he will know where money is being wasted.

The last of the President's suggestions—to turn the collection of books which belong to the Institution into a circulating library—is very good, so far as it goes. For purposes of reference, of course, the Institution library is almost useless, for the reason stated by the President. Before anything else is done to the collection, however, it ought to be overhauled by some competent person, and the gaps filled. The annual volume of Institution Transactions might be greatly increased in usefulness if a list of new books on technical subjects published during the year were inserted in it. Publishers would gladly co-operate in rendering such lists complete. The presidential reference to the Benevolent Fund of the Gas Institute was well conceived; and the appeal for increased support will, it is to be hoped, meet with a satisfactory response. A praiseworthy change in the order of the proceedings this year has brought into greater prominence the annual meeting of the subscribers to the Fund; and this should prove to be beneficial to the finances. It is matter of common experience that these old charities lose their supporters in the ordinary course of Nature, and do not easily replace them. It would be a very regrettable circumstance if the flow of organized charity from members of the Institution of Gas Engineers dried up.

It was only towards the conclusion of his address that the President could find space for a brief statement of the progress of the gas undertaking with which he is personally connected. He made room, however, for a most instructive table showing how the Tunbridge Wells gas undertaking has grown, and how its customers have participated in its prosperity. Like other gas companies, this particular one has found it expedient to do more for the consumer than was formerly regarded as either desirable or lawful. Mr. Dougall was not above garnishing his matter with the graces of poesy; and his peroration was distinctly eloquent. Moreover, he contrived to do without quoting from Burns—a remarkable testimony to the thoroughness of his southern acclimatization! Altogether, the address was eminently suited to the occasion; and we make no excuse for repeating the declaration that, on the evidence of this extremely well-conceived and well-written composition alone, the new Institution has been very fortunate in its first President.

The customary vote of thanks for the address was moved in a graceful speech by Mr. Corbet Woodall, who, if he had chosen to do so, might have claimed credit for earlier efforts made in some of the directions indicated as advantageous for young engineers; and as the President had expressed the desire that the subject-matters of his suggestions for the future work of the Institution should be discussed, this was done with much zest by numerous members, whose views generally harmonized with those contained in the address. The idea of Local Sections appeared to be popular. Mr. Alderman Miles, the Mayor of Bolton, approved the suggestion that gas directors and chairmen of corporation gas committees should be generally invited to attend the meetings of the Institution; and it was agreed that the liberal support of both gas companies and committees would be necessary if the Institution is to enter upon the extended field of usefulness surveyed by the President. Point was given to the discussion, by the passing of a resolution favouring the formation of a Sub-Committee of the Council to inquire into the matter, with a view to some action being taken by next year's meeting. The papers by Mr. Walter Grafton and Mr. S. O. Stephenson (reproduced elsewhere) were then read by the authors, and the discussions postponed to the following day. In the evening, a well-attended and thoroughly successful *conversazione* was given by the President and Mrs. Dougall (accompanied by Miss Dougall) at the rooms of the Royal Institute of Painters in Water Colours, Piccadilly.

The business of Wednesday began with a brilliant lecture by Professor Vivian B. Lewes on "Candles and Calories"—a study which few have prosecuted so thoroughly, and certainly none could discourse upon more acceptably to such an audience as he had. As usual with Professor Lewes, his lecture had a novel and striking practical illustration, in the shape of a very powerful incandescent light obtained from stored "producer" gas, by the Tatham burner. The lecture must be attentively perused by everyone interested in the latest developments of the subject.

The paper by Mr. Walter Grafton, which was the first taken and discussed, is an honest and painstaking effort to grapple with a number of points in connection with the "Photometry and Testing" of illuminating gas, which are only too numerous and varied for adequate treatment in a single paper. The natural result was that discussion proceeded upon one or two of these points, leaving the remainder, for all their importance, to be considered later. Really, the paper and the discussion might be resolved into a criticism of test-burners for photometrical use; and in this regard some useful information was elicited.

Mr. Stephenson's paper was somewhat misnamed. It bears the title of "The Lewes Process at Tipton;" but really it proved to be a description of an arrangement, which is the author's own, for turning Dellwik water gas through some coal-gas retorts. This idea, although recommended by Professor Lewes, and in a way adopted by him, is old, as the Professor himself willingly admits. When one thinks of a Lewes gas process, it is of the methane and coal gas combination at which Mr. Tully, of Sligo, is now working in collaboration with Professor Lewes; but this is not the subject of Mr. Stephenson's paper, of which it is sufficient at present to remark that it contained nothing to unsettle the minds of those who have placed their confidence for auxiliary gas making in carburetted water-gas plant of the Lowe type. On the contrary, so far as the author's statements went, they tended distinctly towards confirming this faith, which is that of the majority, who entertain a reasonable distrust of all benzol enrichment processes. The discussion upon the paper was exceptionally lively and well sustained. The spectacle of two such smart debaters as Mr. A. G. Glasgow and Professor Lewes engaged, each in defending his own ground and attacking that of the other, was enough to fill the hall, as it did, with an appreciative audience, thoroughly enjoying the dialectical skill displayed on both sides.

During the afternoon, the members generally visited the offices of the Gaslight and Coke Company at the Horseferry Road, to inspect an installation of the "Selas" system of intensified gas lighting, both for high and low pressures, to be described the following day by Mr. F. D. Marshall, and also to see in action the "Flicker" photometer for high-power and differently coloured lights, of Messrs. Simmance and Abady, which was one of the features of the meeting. It was a source of great and legitimate satisfaction, to all the British gas engineers present on this occasion, that in this exquisitely clever and indispensable instrument, an English production of first-class importance in gas technics has at last appeared to challenge the monopoly of innovation in this regard held too long by foreigners.

On Thursday, Mr. Marshall read his exhaustive paper on the "Selas" system, and was followed, albeit not precisely "on the same side," as law reports say, by Mr. A. W. Onslow and Mr. Sugg, each describing his own labours in a similar field. It would be invidious, in the circumstances, to single out for particular mention any special advantage or drawback of the different systems in question. Probably for the same reason, those who took part in the combined discussion on all three papers, though fit, were few. The matter is so fully before the technical world, that it will be the fairest treatment to allow it to stand as it appears in the reported proceedings. In the afternoon, the members came back to hear Mr. Arthur Valon's suggestive paper on what practically amounted to the proper treatment of depreciation in regard to gas undertakings. The subject has been discussed recently at some length in the "JOURNAL," and there is consequently not a great deal more to be said about it for the present, except to remark that the whole question of what is fair and proper can be summed up in the statement that it should be the guiding rule of gas finance to have the dividend and interest earning capital fully represented by assets, understood as susceptible of realization at a just valuation. The last paper read was Mr. J. Ballantyne's description of sulphate making on the vacuum principle, which aroused some criticism. It appears to be a laudable attempt to turn to an industrial use in gas-works the exhaust steam, which is otherwise unutilized. The cycle of operations described by Mr. Ballantyne strikes one as very symmetrical and complete; and it is to be expected that more will be heard of this kind of sulphate plant in the not-distant future.

The formal business for concluding the meeting was split into two divisions, and quickly despatched. Mr. H. E. Jones was welcomed by acclamation as President for the ensuing year. A proceeding not merely formal, but transacted by request in the privacy of a Council meeting, was the presentation of a testimonial to Mr. J. Davis, in recognition of his services as Honorary Secretary of the Gas Institute. Next year's meeting is to be held in London; and so, with quite a coruscation of congratulatory speeches more than usually appropriate and deserved, the first meeting of the new Institution of Gas Engineers passed into history, leaving the pleasant memory of a great success in the mind of everyone who participated in it.

A SKETCH OF THE PROCEEDINGS.

(*The Usual Full Report Commences on p.* 759.)

THE time appointed for the commencement of the first annual meeting of the Institution of Gas Engineers last Tuesday morning was half-past ten; but just before the hands of the clock reached that point, the meeting-room of the Institution of Mechanical Engineers and the precincts did not give any great hope of a large attendance of members. But there was a little delay in starting the proceedings; and the quarter-of-an-hour's grace which this afforded made such a marked difference that, when the President (Mr. Andrew Dougall, jun.) stepped on to the daïs, he was welcomed with universal heartiness by a vast assemblage of *confrères*. He was accompanied by something like a dozen of his colleagues, among whom were the Vice-President (Mr. H. E. Jones) and the Honoray Secretary (Mr. James W. Helps). Sir George Livesey had also been induced to take a seat with the representatives of the Council. There was no outer indication whatever that the occasion was an exceptional and historic one for the gas profession. Just in the conventional way, as though there had never been such a thing as a gap in the unity of professional organization, the large meeting settled down seriously to business. Looking round, and seeing numbers of the old faces who had been accustomed in years long since to meet annually under the same roof for technical work, one could easily regard that which has been talked so much about as amalgamation and so forth, as merely the establishment of the *status quo ante*, and nothing more.

Business commenced with the reading by the Secretary (Mr. Walter T. Dunn) of the minutes of the special general meeting of Feb. 26; and they were immediately confirmed. Succeeding this little formality came the report of the Council, which was merely a short statement of the work which has occupied their attention since their appointment. The members heard with extreme satisfaction, and punctuated the announcement of the figures with applause, of the large proportion of the members of the two old societies who have become members of the new. The membership of the old Institute was 672, and of the old Institution 239—together 911. But as there were 67 who belonged both to the Institute and Institution, the total number became 844. There were 113 members of the old Institute and 13 of the Institution who did not apply for membership. But adding to the first list of members 48 new nominations which have been passed by the Council, the total membership is 726, as compared with 844. This is an excellent result, and better than many outside the Council had imagined would be the case. As to finances, the new Institution receives funds from each of the old societies after the process of winding up has been accomplished. The report concluded with an intimation that the Council are proposing to consider the adoption of some scheme whereby the Institution can be rendered of "real practical value" to the members, and of benefit to the gas industry generally. The subject was afterwards dealt with at length in the President's address; and the view of the meeting, and the movement made in assisting the Council in their laudable aim, will be referred to presently.

Coming upon the satisfactory announcement as to the condition of the membership, the members received with profound regret and signs of sympathy the statement from the chair that, although so young, the Institution has already lost by death two of its members—Mr. R. Ross, of Dungannon, and Mr. H. F. Packham, of Kingston-upon-Thames.

Then came the presentation of the premiums awarded by the Gas Institute for papers read at Southampton last year. The first was to Mr. Dugald Clerk for the didactic paper he gave on "Large Gas Engines and the Gases Used by Them." All associated with the gas profession can heartily echo the words with which the President accompanied the offering to Mr. Clerk of the President's Medal and a cheque for £10. "The gas industry," he said, "is much indebted to you, Mr. Clerk, for your original work on the development of the gas-engine; . . . . and I trust your inventive mind will continue to find employment in this direction. The gas engineer will not be slow to produce the necessary cheap gas." Mr. Clerk's words of acknowledgment were

few and sincere; and his desire that the cheque should be placed to the credit of the benevolent fund was deservedly much applauded. The medal, however, he will always greatly prize. The second premium—a cheque for £6—fell to Mr. J. P. Leather for his paper on "The Valuation of Gas Oils." It was gratifying to hear the President's graceful recognition of the appreciation in which Mr. Leather's original work in this direction is held. To Mr. R. G. Shadbolt went the third premium for his paper on "Sunday Rest for Gas Workers." It is to the President a matter for amazement that, in this Christian land of ours, it should be necessary to discuss this question at all; and he hopes that those responsible for the conduct of gas-works will not allow questions of convenience or expense to influence them in breaking the Sabbath day. All merit with regard to the manner in which the paper was presented was disclaimed by Mr. Shadbolt; and he believes that the premium was awarded to him rather as an expression of the sympathy which the Council and gas engineers undoubtedly possess towards their workmen. This was a very nice way of putting it; but the members appreciate on a higher scale than Mr. Shadbolt himself apparently does his personal work in this direction.

Distinguished Honorary Members—A Bolt from the Blue.

The only rift in the harmony of the proceedings during the week came on the resolution electing to honorary membership Mr. George Bray, Mr. Thomas Fletcher, Mr. Joseph Hepworth, Professor Vivian B. Lewes, and Sir George Livesey. But the incident is hardly one to be regretted, as it did more than anything else could have done to reveal the strength of the support the Council possess among the general body of members. Proposed from the chair, the resolution was appropriately seconded by Mr. H. E. Jones, who is happy in the remembrance that he proposed "the original resolution which formed the bridge to an occasion of such congratulation and pleasure as this." Unnecessarily in such an audience, but in kindly spirit, he commented upon the fitness of each nominee for the proposed honour. Then Mr. Isaac Carr elicited the information that the gentlemen named did not represent the full list of honorary members, but were only those who were nominated by the Council under the rules now in operation. Then came the little outburst of opposition. The feelings of Mr. W. Smith, of Bolton, appeared to have been much outraged by the proposal that Mr. Bray and one or two of the other gentlemen named should be proposed for this honour, while the names of other gentlemen in the gas trade evidently to his mind equally eligible had been rejected. He recalled the part that Mr. Bray had taken in bringing about the severance in the ranks of the profession; and to have his name mentioned for honorary membership at the first meeting of the Institution did not at all accord with Mr. Smith's notions of right. He therefore moved, as an amendment, that Mr. Bray be not elected an honorary member. For the purpose of putting the amendment in order, Mr. W. Prince seconded it. It was pointed out by Mr. Jones that the amendment was practically a proposal to expunge a name that the Council had unanimously placed before the members. He urged them to be catholic and united in this matter, and appealed to Mr. Smith not to allow the discussion to continue. Not seeing why Mr. Bray should have preferential treatment, Mr. Smith declined to withdraw his amendment. "For the sake of peace," Alderman Miles, the Mayor of Bolton, also entreated Mr. Smith to withdraw it. While admitting that no gentleman could influence him in this matter so much as Alderman Miles, Mr. Smith still declined to withdraw—this being a matter of principle. The amendment was put; but out of the large assembly not more than a dozen hands were held up in its favour. The vote, in fact, is one which both the Council and Mr. Bray must regard with the utmost satisfaction. Cordial support was then given to the motion by Mr. C. E. Jones; his view, put with his usual touch of humour, being that the Council, instead of being too prodigal in their selection of honorary members, had been rather too modest. This little piece of levity pleased the meeting, discussion ceased, the President put the motion, and it secured a unanimous vote. There were only two of the new honorary members present—Sir George Livesey and Professor Lewes; and on rising they were greeted with *eclat*. Sir George told how it is forty years since he first of all attended the meetings of the original Association; and he had never found himself in a more embarrassing position than this. What he felt is centred in the words: "A greater honour you could not have done me than in electing me to be an honorary member of this Institution." Touching on the little eruption which had just been witnessed, he said this: "But for George Bray, this union would not have taken place. We are very much indebted to him for the great magnanimity he displayed when he said to the old Institute, 'If I am an obstacle to union, I am willing to retire.'" Further, "Mr. Bray is a hard hitter, and he says hard things. But he is an honest man; and he never made use of the Institute to further his personal ends." All present knew how true also were his subsequent words when he said, "I have been devoted to gas all my life; and I have tried to do all I can for the advancement of the industry." For the future good of that industry, he once more pleaded for sufficient encouragement to induce young men of ability to enter it. As an after-thought, he reminded those present of their old friend Mr. Charles Sellers, and said how, had he been spared, he would have rejoiced over this day. Appropriate acknowledgment was also made by Professor Lewes, who mentioned that it was fifteen years since he was encouraged to turn his attention to matters gaseous.

Thus pleasantly ended a part of the proceedings which perfidious rumour had said might prove somewhat troublesome. On the cheering subsiding which the passing of the motion with a unanimous vote had occasioned, the President delivered his Inaugural Address.

Expanding the Usefulness of the Institution.

The Address was published *in extenso* in the "Journal" last week (pp. 645-9); and therefore it need not be summarized here. It will be remembered that the President mainly devoted himself to a consideration of some phases of new work which the Institution might usefully take up. In view of the discussion which followed the address, on the President's invitation, it may be well to repeat his enumeration of the suggestions made: (1) Affiliation of the District Associations, with representation on the Council. (2) Carrying on the work of the Gas Companies' Protection Association. (3) Establishment of experimental works and chemical laboratories. (4) Meetings for students. (5) Course of instruction for employees. (6) Prizes for suggestions from foremen. (7) Circulating library.

That the invitation to discuss these matters was a wise one was shown by the result, which, on the whole, was in favour of an extension of the work of the Institution into new channels. Mr. Corbet Woodall declares himself friendly with the whole seven proposals; and the full report of his remarks will be found to contain information as to gas-works that are working on their own account on certain of the proposed lines. To do something to assist in drawing into the industry the class of men desired is, in his opinion, a matter eminently deserving of the consideration of the Institution; and the establishment of a technical laboratory is a scheme which has had his approval on previous occasions—in fact, he knows of no better way in which gas companies and committees can spend money than in carrying on such an institution. It was Mr. Woodall's pleasure to propose a vote of thanks to the President for his address; and this Mr. R. G. Shadbolt seconded. If, in this gentleman's opinion, the first suggestion of the President is secured—the affiliation of the District Associations with representation on the Council—the whole of the other work indicated would follow. A further suggestion came from Mr. H. E. Jones, that the offering of more medals would promote the obtaining of strong technical papers. While believing the suggestion as to a central laboratory worth consideration, Mr. J. P. Leather is a firm believer in individual work, and much benefit he opines would accrue if engineers could only get their boards and committees to help in such research work. For the central laboratory, he thinks a subscription from gas undertakings on the same basis as the contributions to the Sulphate of Ammonia Committee would be more preferable than asking for subscriptions in an indefinite way. Mr. J. W. Helps holds contrary views. Small works cannot afford to keep a man for research work, while they could afford a small contribution to a central laboratory; and his experience is not favourable to asking for subscriptions in the manner suggested by Mr. Leather. He advised the members to now instruct the Council to form a Special

Committee to fully investigate and report on the points raised by the President. In the judgment of Alderman Miles, it would be an excellent thing to ask chairman of boards and committees to attend the annual meetings; and this would certainly largely assist in obtaining subscriptions. Mr. S. Meunier supported Mr. Helps's proposition. Mr. C. Stafford Ellery, who moved the adoption of the suggestion as to the appointment of a Special Committee, is rather in favour of investigations being carried on in gas-works after the manner of the naphthalene inquiry of the Southern Association. A ready seconder was found in Mr. H. Lees. There were other speakers; and the result was that the motion was unanimously adopted, as was also Mr. Woodall's resolution thanking the President for his address.

The remainder of the sitting on Tuesday was occupied by the reading of the paper by Mr. Walter Grafton on "Photometry and Testing," and of that by Mr. S. O. Stephenson on "The Lewes Process at Tipton." The discussions were adjourned till the following morning. To preserve the usefulness of this sketch, the contents of the papers will be outlined in conjunction with the discussions.

The Benevolent Fund.

The wisdom of changing the time for holding the meeting of the contributors to the Benevolent Fund was exemplified by the large attendance of members (the interest of some of whom is sure to be aroused) at the opening of the sitting on Wednesday morning. From remarks by the President, it transpired that previous to the commencement of the general business on the second day of the annual meeting will in future be the appointed time for the consideration of the affairs of the fund. The formal business on this occasion only consumed a few minutes. Before the report (which showed a total income of £192 6s. 7d., and grants amounting to £88 15s.) was adopted, appeals were made by Mr. T. H. Martin, Mr. H. E. Jones, and Mr. Corbet Woodall for more substantial help for this deserving charity. The gratifying statement was made by Mr. Dougall that already additional subscribers, contributing £30 3s., have been obtained, excluding Mr. Dugald Clerk's donation of the previous day. New rules to meet the altered condition of affairs on amalgamation were adopted; and Sir George Livesey, Mr. W. J. Warner, and Mr. T. Newbigging were appointed Trustees.

Candles and Calories.

For his lecture, which preceded the discussions on the two papers read the previous day, Professor Vivian B. Lewes had a full attendance. Expectation ran high; and, as usual, where the Professor is concerned, expectation was not disappointed. From begining to end, he held his audience; and it was one of the most instructive and opportune deliverances that the profession has ever had from him. In his opening sentences, he attached the attention of the packed meeting by the assertion that the altered conditions of gas manufacture, brought about by the happenings of the past few years, demands an entire rearrangement of the methods of valuation as applied to gas manufacture. He predicts that in a short time the gas industry will, in addition to the standard of illuminating power, have imposed upon it a standard of calorific value; but he warns the industry to exercise the utmost care in finding out, before the initial step is taken, what these standards of calorific value mean. Very briefly he treated upon the question of gas testing; and here he gained the hearty approval of his audience when he said that what was needed at the present day in this regard was not so much scientific accuracy as common sense. There is no definite relation he finds between candle power and calorific value, because the latter is entirely dependent on the composition of the gas. But it is comforting to know that, if rational methods of testing illuminating power are accepted, it is possible, by making an enormous number of experiments, to arrive at an average relation between calorific value and illuminating power. The lecturer described and illustrated the methods of determining calorific values of gases by calculation; but he gives to the calorimeter the credit of being the far easier method. He specially named the Junkers and the Simmance-Abady calorimeters, the differences between which he finds, from a large number of experiments, to be no greater than the differences existing between individual tests—the one is as good as the other. Another note of warning was made here as to the necessity of seeing that the thermometers used with these instruments are carefully calibrated for the range of temperatures at which work is likely to be done. A minute difference in the calibration will introduce very serious error in the results.

For many years, the Professor has been working on a chart the calorific values of gas from different parts of the country, to see whether it is possible to establish an average relation between the calorific value and the illuminating power; and running a line through the centre of the points on a diagram representing several thousands of determinations, shows the lines are "absurdly straight." The straight line is brought about, as Professor Lewes humorously expresses it, by there being an equality of divergence on both sides of it; but it may be said that the straight line presents a fair average calorific value. A further warning fell from the lecturer as to the uselessness of research work on calorific power where gas is stripped to obtain a lower illuminating power; and he enlarged on the importance of calculations being obtained direct from gas properly produced. The lecturer reiterated the statement in his last Cantor Lectures that it is an utter fallacy to suppose that a drop in the light to be obtained from an incandescent mantle takes place with the fall in the calorific value of the gas. If a rich gas is used with incandescent mantles, and every care is taken in arranging the air supply, it is found that, with a lower quality, especially with carburetted water gas, much better results are obtained from the mantles. It is the intensity of the flame, and not the calorific value of the gas employed, that is the important factor.

In the same Cantor Lectures, Professor Lewes pointed out how he had realized with blue water gas and incandescent mantles an illuminating power of 19 candles per cubic foot. Strache's burners are advertised on the Continent to give with blue water gas 20 candles per cubic foot. The Professor's next remark tickled the audience—including Mr. Glasgow. "My dear friend Mr. Glasgow, in his firey, untamed letters, has questioned this." A number of correspondents have also been sceptical. Consequently the lecturer has repeated his experiments, and with an old fuel-gas burner hailing from Philadelphia, he has obtained 19·38 candles per cubic foot of gas. Water gas has a value of 330 British thermal units; and this gas is found to give a better value with incandescent mantles than many of the coal gases possessing a value of 640 or 650 British thermal units. Producer gas, too, gives most excellent results; Professor Lewes having found that he can get 150 candles out of a mantle with this gas and an ordinary "C" burner. Here the lecturer gave the members a startling demonstration. A large cylinder of producer gas was lying under the President's table; and from this source of supply, with an ordinary "C" burner, a Welsbach mantle, and a pressure of 2 inches, he obtained a dazzling light. The secret is that, instead of the burner consuming only (say) 3·7 cubic feet per hour as with ordinary coal gas, it was burning between 20 and 30 cubic feet of the producer gas—that is to say, what was giving the candle power was not the calories in the gas (not the thermal value), but the fact that a much larger volume of gas was being compressed into the flame, with the result that a hotter flame was secured. In other words, an enormous amount of heat was being developed in a small space.

The last part of the lecture was devoted to a description of the Simmance-Abady "Flicker" photometer, which has given the Professor great delight; he having found perfect agreement between it and a 10-candle pentane photometer with expert observers. On all these points a great deal of instructive information can be collected from the text of the lecture, as published in other columns. For his brilliant performance, Professor Lewes was enthusiastically thanked.

Photometry and Testing.

As stated in the summary of Tuesday's proceedings, Mr. Walter Grafton was the first of the contributors of matter for discussion to occupy the platform; and his paper was composed of criticism of "weak spots remaining in the present system of testing in London," suggestion, experiment, and the results of most careful work. If there is one thing more than another about Mr. Grafton's writings, it is that they bear the stamp of the conscientious worker. Dealing with the table photometer, he admitted that the 10-candle pentane lamp is an admirable standard; but he points out certain deficiencies and loopholes for errors. He criticizes the Notification of the Gas Referee as to the method of using the lamp; and his experiments prove that variations do take place in connection with it. In order to bring the variations down to as small a compass as possible, it is

necessary, he points out, that the lamp should be regulated by the outlet of the carburettor—the inlet being wide open. Then, with regard to the height of the flame, it is essential that it should be kept to a fixed point, and that a proper mark should be made on the lamp, so as not to allow the height to vary. He insists on the necessity, in making official tests, of being exact, and particularly so when a little more or less length of flame makes quite enough difference to cause the penalizing of the gas suppliers. The paper includes information on the effect of temperature in the way of producing variations in the pentanized air. The conclusion at which the author has arrived is this: When the parts of the lamp have become thoroughly heated, and the vapour regulated by the outlet-tap so that the flame is $2\frac{3}{8}$ inches in length, and the chimney tube set when cold to 47 mm. above the steatite burner, the standard is worthy of being called by that name, and is as reliable as it is possible to get one. The aërorthometer came in for condemnation. Correcting by it, the author alleges it is against the gas to the extent of 0·11 candle. As to the photoped paper, he has found a fine grained paper, slightly tinted yellow, to be far more sensitive than the white paper. Regarding the regulating-tap, he considers that the hole in the plug is quite unnecessary, and a longer saw-cut is more desirable. His experience goes to show that reliance can be placed upon results that are made with an inlet pressure of $1\frac{1}{2}$ inches, and the index readings falling between 12° and 16° on the arc. A table is given by Mr. Grafton to show the effects of variations of pressure on the apparatus; and the results seen therein point to the necessity for a definite figure being given in the Gas Referees' Notification.

In the succeeding part of the paper Mr. Grafton deals with the argand burner. This, he asserts, is admirable so long as it is supplied with 16 or 17 candle coal gas, and gives practically the full duty of 3·3 candles per cubic foot, when burned at the rate of 5 feet an hour. The argand burner, he asserts, does not do full justice to the gas under present conditions. With the introduction of oil carburetted water gas, the mixtures of 16 candles and under this value, as determined by the argand burner, either by a 5-feet rate or a 16-candle flame basis, are undervalued; and consumers and manufacturers are deceived by the results at present obtained. The burner is just suited for consuming, at the 5 cubic feet per hour rate, such carburetted gas of 20 to 23 candle value, but no more. Again, since the South Metropolitan Act of 1900, all new Acts providing for a lowering of the illuminating power to 14 and 13 candles prescribe the "London" argand with this precautionary measure—that the gas should be consumed to give a 16-candle flame in a 6 in. by $1\frac{3}{4}$ in. external diameter chimney, calculating back to 5 cubic feet. But the author does not say that the 16-candle flame method does full justice to the gas. He contends that 15, 14, or 13 candle gas should be respectively tested with a 15, 14, or 13 candle flame, and not with a 16-candle flame. He is most emphatic in saying that it is unscientific. Further, he holds that the 5 cubic feet rate of consumption is one to be adhered to. He also deals with the effects of chimneys upon the quantity of air drawn in. He goes on to refer to his modification of the "London" argand, which he maintains fulfils the requirements of modern gas making. (This burner was described in the "JOURNAL" for Feb. 17 last.) He shows the improved efficiency realized by the burner; and in a table gives the results obtained by the "London" argand in comparison with his own burner and the "Wandsworth" burner—the results showing that, in every case, the official method of testing the gas substantially undervalues it. With regard to the air supply to the burner, his experiments also show that the recognized quantity does not hold good, according to the nature or composition of the gas. The paper is so full of points, that what appears here must not be taken as anything more than a bare indication of part of its contents.

The discussion which was taken after the lecture on the Wednesday morning was full, but even then not so extensive that it dealt thoroughly with the paper. It was pointed out by Mr. Webber that the use of the "London" argand burner at the 16-candle flame rate has gone a long way towards making this particular burner applicable to determining the illuminating power of various qualities of gases. Why the "London" argand burner is used in this way is because it is the only standard burner known to either law or technical practice. He fails to find in the paper any indication that the absolute perfection of a burner for developing all that there is in different kinds of gas has been arrived at. The gas industry has suffered in this matter of illuminating power from imperfect standardization; but Parliament, in his opinion, are waking up to the matter. The point of some remarks by Mr. H. E. Jones is that, for 14-candle gas, he has found that the old "Wandsworth" or "Brentford" burner is far ahead of others. This, he stated, is nothing more than the old 15-hole argand burner, with 7-inch chimney, which Dr. Letheby prescribed. He gave Mr. Sugg the credit for having, nearly thirty years ago, read a paper in which he pointed out that, for different qualities of gas, different burners were wanted. He agrees that it is a step in the right direction to check the air supply to the inside of the flame, as in Mr. Grafton's burner, but it is not so good as checking it both inside and outside.

Mr. Isaac Carr emphatically asserts that consumers are suffering by the reduction in the illuminating power of gas that is now proceeding. For this lower power gas, he contends that the present statutory method of testing must be adhered to. Distinguishing between the terms "cheapest light" and "cheapest gas," he maintains that the cheapest light in London is that sold by the Gaslight and Coke Company. As a result of the Departmental Committee of the Board of Trade, Mr. W. Sugg believes we shall have a standard prescribed for both calorific value as well as illuminating value. He again urges, as he urged many years ago, that the proper way to test gas of various qualities is to have a special burner for each quality of gas. If this had been done when he first advocated it, there would not now have been any question about the testing of 14-candle gas. In his opinion, the principle adopted by Mr. Grafton, of putting a little collar inside the argand burner for restricting the air supply to the centre of the flame, is not so good as putting a vertical peg through the centre of the burner. Pointing out that in the table photometer, we have got rid of the 5 cubic feet rate, Mr. Lacey expressed the opinion that to adopt a method of constant rate of flow, instead of constant light, would be going a retrograde step. If the Referees' 16-candle light is adhered to, the table photometer, he believes, is an instrument in which one can have some confidence.

Professor Lewes holds that there is nothing wrong with the standard "London" argand; but it is the 5 cubic feet rate which is "the demon of the play." He complimented Mr. Grafton on having done his work on the modified burner exceedingly well; and he personally vouched for the accuracy of the results recorded in the paper. For 14-candle gas, however, the "Wandsworth" burner does better. If a constant rate of flow is to be maintained, there is no getting away from the fact that there must be a new standard burner for every candle power. The reason Professor Lewes would like to see the "London" argand continued is that, by simply altering the definition of the rate of flow—for instance, 14-candle gas at 5·71 cubic feet per hour—then they had a test that could be put at once into any gas-works in the kingdom. Mr. Grafton's retort to Mr. Webber's remarks as to the "London" standard argand being the only burner known to either law or technical practice is that the 10-candle pentane has been substituted for candles. If experts cannot agree upon the burner to be used, then better treatment cannot be expected from opponents. The point of the paper, he reminded the members, is not the supply of high or low quality gas, but that the official burner does not give the full value required of it. The burner is there to give the gas manufacturer the full value of his gas, and not the low return obtained by the consumers with flat-flame burners. As to the air supply, he pointed out that it is the internal supply that governs the amount of light from the argand burners, and not the external supply at all. By regulating the air supply as in his burner, a steadier flame is secured than when it is done by means of a peg, as suggested by Mr. Sugg. With Mr. Grafton's closing remark, that he hopes the paper will tend towards the furtherance of a better method of arriving at the proper value of various qualities of gas, readers generally will be in agreement.

THE LEWES PROCESS AT TIPTON.

Mr. Sidney O. Stephenson, of Tipton, was the first in this country to adopt the Lewes proposal of utilizing blue water gas (as produced by a Dellwik plant of 300,000 cubic feet capacity) on the full working scale. He is therefore entitled to the credit attaching to his pioneer work; and the

results of his experiences must be of interest to the gas profession at large. Some of the results have been published in the "JOURNAL;" and to their publication is due Mr. Stephenson's appearance with a paper on the subject at this meeting. It was the one next discussed. The chief interest of the contribution is found in the further results which the author gives. He states the reasons which led to his adoption of the system, describes the difficulties which he encountered in applying it to the conditions existing at Tipton (which conditions, however, may not exist in precisely the same measure elsewhere), and tells how he overcame them. Then he goes on to relate the disappointment first experienced; finally coming to the success which rewarded him. Here Mr. Stephenson reproduces the figures obtained from the careful test of Mr. H. F. Hills (Professor Lewes's assistant) in February, and which were quoted in the author's communication to the "JOURNAL" for March 24. Following this he supplies the actual figures from his working records for March and April. They are: Water gas added, 12·92 per cent.; total coal carbonized, 1517 tons 9 cwt.; purified gas made, 20,702,000 cubic feet; water gas added, 2,369,000 cubic feet; total make per ton, 13,642 cubic feet; make per ton, deducting water gas, 12,081 cubic feet; illuminating power (enriched), 15·25 candles; benzol used per 1000 cubic feet of mixed gas, 0·072 gallons.

These results have occasioned much surprise; and, for the satisfaction of his colleagues, Mr. Stephenson mentions the causes to which he attributes the high yield of coal gas. The first is the prevention of the decomposition of hydrocarbons; and the second that a portion of the tarry vapours are permanently converted into illuminating gas—the water gas in both cases acting as a useful carrier. The fact that he has obtained this large increase in volume of coal gas with the addition of small percentages of water gas, and that the yield of coal gas is not greatly further augmented by increasing the percentage of water gas, seems to confirm the theory of the gasification of tarry vapours. Certain it is, he holds, that the water gas not only gathers a part of its enrichment in the retort, but, in doing so, increases the yield from the coal, and that to no inconsiderable extent. Incidentally, he states that he has not recently had any trouble from naphthalene either in or out of the works, and very little in the way of stopped ascension-pipes or carbon deposit in the retorts. Mr. Stephenson admits that it is hardly possible for him to give reliable figures until he has had a full year's operation to serve as a complete comparison of costs between the working of the process and ordinary coal-gas manufacture. Including the items of labour, coke for generator, fuel for boiler, benzol enrichment, purification, less 0·75d. saving in extra make of coal gas, his cost for blue water gas works out to 9·38d. per 1000 cubic feet. This is on intermittent working, and coke charged at 11s. per ton. The charge for repairs and maintenance cannot yet be arrived at. The cost of coal gas manufacture at Tipton last year was, including wages, coal and other materials, purification, and repairs and maintenance, 19·72d. per 1000 cubic feet; or, deducting residuals (8·41d.), 11·31d. In addition, the cost of management and office expenses was 1·01d., and distribution 1·27d. He mentions in his concluding sentence that all the carburetting necessary is done at the outlet of the station meter, so that this cannot affect the figures as to volume.

The discussion was carried to considerable length, and exhausted more than the remaining time set apart for the sitting on Wednesday. In fact, those who faithfully saw the proceedings through that day from beginning to end kept their seats for a full five hours. However, it cannot be said that the discussion satisfactorily solved the problem as to the *raison d'être* of Mr. Stephenson's increased make. Various suggestions were made; but there is still a mystery about it, though no one disputes the facts. The whole substance of the speeches cannot be traversed here; but some of the features may be indicated, and these will bring out a few points not noticed in the epitome of the paper. Seeking for a reason for the increased make, Mr. A. E. Broadberry found that Mr. Stephenson is using special care in the retort-house, is working with a dry main (which the author says gives the advantages of "an increased yield of gas, and a slightly better quality"), and is working his retorts under a vacuum—all of which, Mr. Broadberry thinks, may probably have more to do with the production of the 12,000 cubic feet of gas than the introduction of the blue water gas into the retorts. From his large experience, Mr. Broadberry also combatted references by Mr. Stephenson to troubles occasioned by the oil tar, giving figures showing that carburetted water gas has not in his case had any injurious effect on the diaphragms of consumers' meters. Mr. D. T. Livesey brought out the point that for every ton of coal Mr. Stephenson had delivered on to his works, he can produce a total of 51,000 cubic feet of gas. If the quantity of coke made is taken, and it is reckoned that 10 cwt. of coke to the ton can be used, then 42,000 cubic feet of 15¼-candle gas is made at Tipton per ton of coal, with 10 gallons of benzol. This Mr. Livesey regards as almost a record. The same speaker elicited the information that 90 per cent. benzol is used, and that 14·7 candles was the illuminating power of the coal gas tested by Mr. Hills. The experience of Mr. Alex. Allan at Scarborough also leads him to think that a great deal of the extra make per ton attributed by the author to the Lewes process is due to working with a dry main. In his own case, he finds an increase of from 700 to 1200 cubic feet per ton when working with a dry main, compared with working with a hydraulic main. Changing back to the hydraulic, the make, he finds, falls considerably. If, he also pointed out, the author is correct that his increased make is partly due to the tarry vapours being converted into illuminating gas, this would tend to a decrease in the make of tar.

Experiments he has made on similar lines, Mr. Botley says, have resulted in an increased volume of gas, but a decrease in illuminating power. This is using Durham coal, in which the quality of the tar is not great. Invited by the President, Mr. A. G. Glasgow criticized the paper on a large number of points. He regards the statement of the author on his working while passing blue water gas through the retorts as somewhat incomplete. The paper, he complains, contains no comparison whatever with the working under normal conditions, nor any facts by which the accuracy of the conclusions of the author can be tested. Mr. Glasgow specifically mentioned the points he wished information on. With Mr. Broadberry and Mr. Allan, this astute critic is under the impression that Mr. Stephenson may look to the simple changes he has effected in his carbonizing work for the credit he gives to the passing of blue water gas through his coal-gas retorts. The causes to which Mr. Stephenson attributes his increased yield of gas were severely handled by Mr. Glasgow; but the argument would spoil by summarizing it. With regard to the Lewes process, there have been, he mentions, inventions going back as far as the year 1830 which may be held to have anticipated it. Later, Mr. Glasgow cordially recommended everybody, including himself, Mr. Stephenson, and Professor Lewes, to read or re-read Mr. William Young's recent contribution to the "JOURNAL," which, though it is not in his favour as a promoter of the Lowe system, he describes as one of the most interesting, able, and intelligent presentations on this subject that he has ever seen. After all, Mr. Glasgow has experience which tells him that there is some enrichment to be obtained by admitting blue water gas into coal-gas retorts, but not a particle more than can be realized by admitting it into the hydraulic main or to any other point where it is in the presence of tarry vapours. There appears to be no doubt whatever in Mr. A. F. Browne's mind that Professor Lewes's results have been confirmed at Tipton. He cannot, however, understand how a retort is not going to be cooled by the cold stream of gas passing through it; nor, therefore, can he see how the make of gas per ton of coal is to be increased by anything more than the small addition of the benzol and the other hydrocarbons that would be otherwise carried off by the tar. As to the abolition of the seal, the experience of the author, it appears, is not that of the South Metropolitan Gas Engineers. At one of the Company's works in which the dry main has been introduced, the make of gas, instead of increasing, has really shown an absolute deficiency.

Attention was next of all called by Mr. J. P. Leather to the statement in the paper that when, for a short time, the author stopped the process, and returned to coal distillation only, there was actually, under apparently similar conditions, a drop of 600 feet in the production of gas per ton. Where, he asked, does the 600 feet come from. More information is wanted. If this fact as to the increased make is proved to be right, then, he says, gas engineers will have to accept it, and seek for a theory to explain it. A few remarks by Professor Lewes followed. He reminds us that it is some five years since that he stated that there was a great possibility of saving some of the hydrocarbons in retorts by treating them

in a particular manner. Other previous observers in the same direction had failed for certain definite reasons; and if, he said, "you asked me at the present moment what I think of my own process, I should reply I have not the vaguest idea." If a retort is taken, the coal carbonized in it, and then a thin stream of cold gas passed through it, there is a checking of the heats and a totally different set of distillation processes going on than those which obtain at higher temperatures. At the present moment, he confesses, there are not really in existence the figures to argue upon; and he heartily thanked the author for contributing such an honest series of figures from honest working. He pleads for the results of all experiments that are made being put on record, because at present only the fringe of the subject has been touched. Mr. Stephenson's reply showed him to be as anxious as anyone to learn what is actually the cause of the working facts that he presented. He has not found any diminution in his tar, though he thinks that perhaps the little benzol in the tar is taken up in this system of working. As to the charge of incompleteness of statement made by Mr. Glasgow, the author says that he has been working too short a time for obtaining all the results he should like. As to the water gas forming a cold stream passing through the retorts, in his opinion it must get heated before it has travelled very far.

Three Papers on High and Low Pressure Incandescent Lighting.

The sitting on Thursday had to be carried far into the afternoon in order to clear the *agenda*. There was an adjournment for rather more than an hour shortly after one o'clock, by which time the three papers on high and low pressure gas lighting had, by discussing them together, been disposed of. However, the afternoon, until nearly five o'clock, was required for the consideration of the remaining two papers.

Glancing at the papers on incandescent lighting in the order in which they were introduced to the members, the first was on "The 'Selas' System of Intensified Lighting." The author was Mr. F. D. Marshall. In his opening paragraphs, he deals generally with the recognition that has been made by authorities on the subject of the advantages to be obtained in developing luminosity from the ordinary incandescent burner by a further addition of air to the coal gas consumed in the burner. The object of the paper is to demonstrate that the results of the so-called high-pressure systems, where the mixing of air and gas takes place in the burner itself, can be reached and surpassed by a low-pressure system, where the gas and air are mixed and intermingled beforehand. This system is that known as the "Selas." The low-pressure apparatus described is constructed on the principle of ensuring a constant and certain mixture of two volumes of air to one of gas, burnt under a pressure of from 2 to 2½ inches, and by incandescent burners consuming 1½, 2½, and 3 feet of gas, or three times these quantities of mixture. The apparatus used, besides a gas and air mixer, is a pressure-raiser in a minor degree. Two forms of the apparatus, worked by a small water motor or an electro-motor, are described in the paper. In the high-pressure machines, the mixer and compressor require greater power —preferably a gas-engine; but a 1-horse power engine is all that is needed for an installation of 80 lights of 1000 candles each. The mixing and compressing machine in this case draws in and intermingles 1 volume of air to 1 volume of gas, and compresses them to 30 inches of water pressure. The best results, it appears, are obtained by consuming the "Selas" mixture in a specially constructed burner, fitted with a mantle of small dimensions. If other high-power burners are used, the air supply should be closed.

To show the economical results to be secured by the "Selas" system as described, the author gives a number of figures obtained under different circumstances. The first set were from tests made with 14-candle ordinary gas and a "C" Auer burner. Regulated to consume 3·5 cubic feet per hour at 1-inch pressure, the results varied from 55 to 85 candles, or an average of 64·9 candles, equalling 18·5 candles per cubic feet. At 1½ inches pressure, and consuming from 4·60 to 5·05 cubic feet, the average obtained was 106·2 candles, equalling 22·3 candles per cubic foot. The author attributes the variations to the unfitness of the ordinary Auer burner for emitting a regular flame temperature—the balance of the heating power of the inner zone being continually disturbed by the whirling motion of the air and the gas induced by the constricted form of the mixing chamber. Using the gas through a "Selas" apparatus, whereby aëration takes place in the proportion of 2 of air to 1 of gas, all luminosity of the flame proper naturally disappears. The average of the photometrical results developed by a "Selas" special burner—consuming per hour, under a pressure at the point of ignition of 2¼ inches, 9·26 cubic feet of mixture, or 3·08 cubic feet of gas—was 105·18 candles, or equal to 34·1 candles per foot. In other experiments, an Auer burner, with the "Selas" mixture, gave 26 candles per foot, as against 17 candles per foot with ordinary gas. To obtain the best results from the "Selas" flame, small mantles and small burners must be used; in other words, the diminished flame due to the mixture of air and gas must, as nearly as possible, fit the mantle. The experiments also show that, under certain conditions, the lower the initial illuminating power of the gas, the higher the flame intensities. From these results, the economy to the consumer, the author points out, is self-evident. As to the high-pressure "Selas" gas, the results included in the paper were obtained from an installation in Berlin. They are approximately as follows: With a pressure of 35 inches of water, a mixture of 1 of air to 1 of gas, and 44·6 cubic feet of mixture per hour (or 22·3 cubic feet of gas), the result is 987 candles, or 44·2 candles per foot. The power required to supply the 75 burners of 987 candles each in this installation is only a 1-horse power gas-engine. The mantles are renewed every six weeks. At present, the author mentions, the durability of the mantle bars the way to further development of heat intensities. There are several sizes of the high-pressure "Selas" burners constructed—the smallest of which, consuming 26 cubic feet of mixture per hour or 13 cubic feet of gas, develops 40 candles per foot. [Throughout the week, the Directors of the Gaslight and Coke Company permitted interested members to inspect an installation of the "Selas" light at Horseferry Road. Mr. Marshall acknowledged their kindness at the close of the reading of his paper. Tests are being made there to verify the results obtained with the system on the Continent. At the outset, such good results were not obtained; but there has been improvement, and now the observers are not only anticipating the confirmation, but the exceeding of the quoted figures. The Simmance-Abady "Flicker" photometer is being used in these tests. This photometer by the way was quite a feature of the meeting; having been referred to approvingly by Professor Lewes in his lecture, and a specimen was on view in the basement of the Institution during Wednesday. Those who saw it, and witnessed its performance, pronounced it to be a cleverly conceived instrument. In this connection, Mr. Simmance's interesting contribution to last week's "Journal" (p. 664) may be commended to the earnest consideration of our readers.]

"Does high-pressure gas lighting justify its existence from an economical and useful standpoint?" is the question with which Mr. A. W. Onslow opens the paper that succeeded Mr. Marshall's, and in which he detailed his latest experiences in this particular field of lighting. His answer is "Yes;" and, further, it is a means of counterbalancing rivals. The author is an ultraist in this matter of high-pressure lighting; and the present paper may be taken as supplementary to the contributions to the subject (which raised so much interest) with which Mr. Onslow has favoured the Southern Association in times past. In his position as Gas Engineer at the Royal Arsenal at Woolwich, he is well circumstanced for experimenting on the higher scales of gas pressure. Estimating the power required for an installation of about 200,000 candles, he takes a rotary compressor or blower with bye-pass valve, which permits of any pressure up to 5 lbs. per square inch being easily obtained. This apparatus is the most economical in working that he knows of. At the time of the test, 166 lamps were used, having a lighting power of 89,000 candles. A 3-inch main leads up to two 3-inch anti-fluctuators, going into one 3-inch pipe at the compressor itself. On the outlet, there are 3-inch connections, and 2½-inch pipe the full length of the building—363 feet. The inlet pressure before starting was 1 inch; and the power for the compressor was furnished by an electric motor. Without going into further details, the summary of the power required was: At 20 inches pressure, both anti-fluctuators at work, 7·1 amperes, or 2·43 brake horse power; motor running on loose pulley, 4 amperes, or 1·37 brake horse power; actual power required to obtain 20 inches pressure from 1 inch, 3·1 amperes, or 1·06 brake horse power; the motor itself absorbed 2 amperes, or 0·68 brake

horse power; and the shafting necessary to break down from 1400 revolutions to 220 per minute, 2 amperes, or 0·68 brake horse power. It should be explained that the blower is actually larger than is necessary, in order to provide for furnaces, gas heaters, &c.; so that for a 200,000-candle power blower only, the power would be even less than that named.

Working and experimenting with pressures running from 20 inches up to 44 inches, great difficulty with burners has been met with by Mr. Onslow. The mantle-rods were found to bend and fuse with the heat, until a nickelled steel rod of the proper composition was found. The necessity of the gauze, too, being of a suitable texture and the material nickel was soon discovered. Much hissing is caused by the gauze; and the alteration in the minutest dimension causes a whistling noise which is simply unbearable at 30 inches pressure. Mr. Onslow prefers a wide bottomed burner to the attenuated style of the Kern, and with the nipple thrust well up in the burner. With this, he says, a much better effect is produced; the air and gas becoming well heated before combustion takes place. The latest burner of this description is giving, at 30 inches pressure, 410 candles, or 33·1 candles per cubic foot of gas (the burner being equal in size to a No. 4 Kern), and 100 candles for a No. 0 burner, or 35·7 candles per foot. As to mantles, for pressures of 20 or 30 inches, they must be double woven, or very thick in texture, so as to compel the gas to remain in a confined area. The author also finds that mantles used for long working periods (twelve to fourteen hours) give a considerably higher duration service than those used for (say) only two hours daily—400 to 600 hours as against 150 hours, at 400-candle power. At Woolwich Arsenal, for open spaces, closed-in lamps 18 inches square are used; and for buildings not subjected to severe draughts, lamps with open bottom, hexagon shaped, and 16 inches wide, are used—if required for two burners of 500-candle power each. All the lamps and burners are suspended on springs with flexible steel tubing—experiences of mantle destruction some time since, through roof and ceiling vibrations and heavy gun firing, having been very painful. Here only a general indication of the main points are given.

[During the luncheon hour on Thursday, Mr. Onslow exhibited a series of four burners, ranging from 900-candle power down to a small one for office use, to illustrate the system adopted at the Woolwich Arsenal. The gas was being supplied through a small blower, operated by a 2-man power electric motor. The exhibit was complete with bye-pass and relief valves for low-pressure lighting when required. The mantles were intensely incandescent; but, of course, being only a small self-contained installation, the lights were not so steady as in a large permanent one.]

The third paper in this category was by Mr. William Sugg; and this veteran in lighting matters had a very hearty reception at the hands of the members. Since Mr. Sugg read his paper before the Gas Institute on high and low pressure gas incandescent lighting in 1901, several advances have been made by him, particularly in regard to the high-pressure method—most of which have been the outcome of the necessity to satisfy varied requirements. These improvements Mr. Sugg now described. His pressure-increasing apparatus, burners, reflectors and lamps have, it appears, all undergone changes to adapt them for particular duties and situations. The efficiency of what the author refers to as his "water-engine" has been raised; and from this improvement can be briefly traced the further advances made by him. In shops and mills where there is a nearly continuous running shafting, some of the pressure-raisers have been adapted to be driven by that means. In conjunction with this arrangement, a bye-pass has been devised, so that the pressure is regulated according to requirements as to the number of burners. The drawback to this mode of working is that, when the machinery stops, the supply of high-pressure gas also stops. But the author has produced a new steam-engine, which, he says, will automatically supply all the burners in a factory with the proper quantity of high-pressure gas at any moment. The engine and the pump are both of them fixed on one base-plate. In some workshops, however, it is better, the author tells us, to use a gas-engine (instead of steam), with a pressure-increaser. The same has been found to apply to certain railway stations and other places, where the water-motor was originally installed—inconvenience having been found to arise from the reduction of the pressure of the water, owing to temporary causes. In these cases, gas-engines have been installed. The author instances the Bristol Joint Railway Station, where travellers in the south-west know that a fine piece of high-pressure lighting is to be seen, and where water-engines have been replaced by two 1-horse power gas-engines. There, as well as at some other stations, the change has effected a saving. The charge for water at Bristol was at the high rate of 1s. per 1000 gallons; but as soon as gas-engines were adopted, the cost of raising the pressure from 12 to 14 inches was immediately reduced to rather less than ½d. per 1000 cubic feet. A 1-horse power gas-engine is able to keep from 100 to 120 300-candle power lamps going continuously. Mr. Sugg makes a point of the fact that the burners he uses for high-pressure lighting will also work at low pressures. Speaking of his bridge lighting work in London, he also states that, by raising the pressure of the gas from 10 to 14 inches, the illuminating power of each burner may be increased from 300 to 400 candles, with an extra consumption (above 10 cubic feet) of only 2½ to 3 cubic feet per hour per burner, according to the quality of the gas. In cases where the gas-pipes are old, the high illuminating power may be produced by putting the air under pressure instead of the gas; and for this purpose the author has devised a new burner, which he describes. With such burners as these, we may look forward to a great improvement in the illuminating power of high-pressure burners supplied with rich gases.

The topics covered by these papers were such that members could talk upon them at large; and before the conclusion of the discussion, there were signs that many present were suffering from a little tedium. The speakers were led by Mr. Charles Carpenter, who, looking at the extremely erratic readings given for the Auer burner with ordinary gas, feared that, if the results given for the "Selas" system were obtained by the same photometer, very little reliance could be placed on them. While he regards the system as very interesting, he says the South Metropolitan Gas Company have obtained about 41 candles per foot of gas consumed by a very simple high-pressure arrangement. In his view, having arrived at such a high duty as this, the question now to be considered is not whether this duty can possibly be increased by 2 or 3 candles, but whether the apparatus or methods of achieving such high results can be modified. Like subsequent speakers, Mr. Carpenter has experienced difficulty in connection with the duration of mantles with lamps of high intensity. For the determination of the illuminating powers of various incandescent mantles, the South Metropolitan Company have had in use for some time a special photometer, which, in conjunction with Mr. Helps, Mr. Carpenter is going to bring before the International Committee on Photometry. The principle of this photometer is the use of a secondary standard of the same quality and colour as the light with which the comparison is required to be made. The Company, it transpires, are letting out high-pressure apparatus on the hire-purchase system, and maintaining the burners at a fixed rate per annum. Two apparent omissions in Mr. Marshall's paper were noted by Mr. T. Canning—that no allowance is made for the gas used in the gas-engine or the electricity employed in the electric motor; nor is there anything put down for sinking fund, depreciation, or interest. The "Selas" system does not appear to him to do any better than other high-pressure systems on the market.

A little curiosity was subsequently evinced by Mr. John West as to the kind of coal from which the gas was made with which the experiments were carried out. From observations Mr. West has been making on the Continent, he is under the impression that the mantles used abroad are better than are obtainable in England. As to the use of low-grade gas for incandescent purposes, he believes that he was one of the first to find that, testing with 14-candle gas in one part of the country and 20-candle gas in Manchester, and with incandescent mantles, the commoner gas gave as good results as the richer gas. In Dresden, he observes that daily supervision by well-trained men is responsible for the constant high efficiency of the incandescent gas lighting there. The experience of Mr. T. Goulden leads him to emphasize the importance of having properly-fitting mantles, as between an ill-fitting and a properly fitting one he has found a difference of as much as 35 per cent. in illuminating power. With the "Selas" light, he has obtained 36 candles per cubic foot; but he says it is evident it is not the maximum to be effected. A good deal of experience has been obtained by Mr. George Stevenson with high-pressure lighting at Long Eaton. He has adopted there an interesting system

of supplying high-pressure gas to the lace mills. These are mostly four storey factories; and what he does is to put a big compressor at the inlet of the rising-main to the factories; and for those tenants who do not want high-pressure lighting, a governor is fixed to the inlet of their gas-meters, so as to reduce the pressure to 2 inches. There have been some complaints as to the effect of the use of these lights on the workpeople; but from experiments made by Mr. W. J. A. Butterfield, it has been shown that the whole of the trouble arises from bad ventilation. By the aëration of gas in incandescent lighting, Mr. Grafton points out that greater economy is gained than by any other system, and the experience realized on this point and the statements made by Mr. Marshall justify his own conclusions of some time since on this subject. Quoting several figures as to calories and British thermal units, Mr. Grafton expressed the wish that some common basis could be arrived at for stating heat values. The importance of mantles not materially altering their shape is the point of a few remarks by Mr. Lacey.

From the several comments of Mr. Onslow on the discussion, it is gathered that he has had great difficulty in getting a good mantle in England for his special purposes; and to Germany it was necessary to go. The mantle he uses really consists of two—one woven on the top of the other. These mantles last 400 to 500 hours. Supervision, a good distribution of light, and ventilation are all points to which the most scrupulous attention is given in the factories at Woolwich Arsenal. It is interesting to note that in the Government buildings alone in different parts of England high-pressure lights to the extent of 1½ million candles have been installed. At the Arsenal, the cost—including mantles, gas, labour, and depreciation—is 1¼d. per 1000 candles per hour. Mr. Marshall seemed to have a little difficulty in accounting precisely to Mr. Carpenter for the variable results obtained with the "C" Auer burner and ordinary gas; but he thinks they are due to the consumption being muzzled down to 3·5 cubic feet. The low-pressure tests were made in Copenhagen, and the high-pressure ones in Berlin—therefore, with different photometers. Mr. Marshall finds the charm of the "Selas" system in the fact that it can be developed for low-pressure or domestic lighting; a duty of above 30 candles per foot of gas being obtained with a consumption of only 1½ cubic feet of gas. As to the omissions to which Mr. Canning referred, Mr. Marshall reminded him that they are matters which concern the "Selas" Company only, as they have made installations abroad on the hire system, as described at the end of the paper. Among other points in the reply, it is learnt that the tests made in Copenhagen were with gas from English coal, and those in Berlin with gas from German coal, which perhaps is a trifle lower in candle power. On the point of mantles, Mr. Marshall says that, before being burnt off, they must be protected from damp. The hygroscopic proclivity of mantles plays a great part in the length of their life; and he finds that, by discarding flash-lights in lamps, the mantles require renewing oftener. There is, indeed, as much as 20 to 30 per cent. saving by keeping them heated by a flash-light.

Official Elections.

At this stage, the President interposed a number of announcements, chief among which are these: That Mr. H. E. Jones is to be the President for the ensuing year, and Mr. Charles Wood, the Junior Vice-President. The Senior Vice-President is Mr. D. Irving. The membership has also been greatly extended, as will be seen by the list in the General Report.

A Capital Recoupment Fund.

The discussion by Mr. Arthur Valon of this subject in the succeeding paper (which was taken first on Thursday afternoon) comes opportunely. In every trading concern having what may be called an engineering basis, the question of the replacement of out-of-date plant with apparatus of modern construction, and the extinction of the capital thus rendered unproductive, has (for reasons stated by the author) forced itself on the attention of those responsible for the management. But in the gas industry, the question has not yet reached the acute stage, although signs are not wanting that the possibility of difficulty in the future is beginning to arouse serious consideration. As he says towards the end of the paper, the evils of dead capital will tend to increase more in the future than in the past; and the effect of competition will likewise be more severe. Mr. Valon shows the importance of the subject, comments on the difficulties attendant on an over-capitalized gas concern, and points to the undesirability of the position. He advances the proposition, which no one can have any hesitation in accepting, that the capital upon which interest and dividend has to be paid should be that amount which has to be expended upon objects from which benefit is being received. Where in any undertaking this is less than the existing capital, then the difference is unproductive or dead capital; and where this dead capital exists, it ought to be written off, and prevented from ever accumulating again. The author briefly instances the variety of ways in which capital accumulates that has ceased to be represented by existing value. Interest, renewals, and repairs, he holds, do not cover the whole fair charge on revenue to which capital is entitled. The item of renewals should be deleted, and recoupment of capital substituted. If this were to be consistently done, then unproductive capital would soon disappear. He finds good ground for animadversion in connection with the usual custom of charging renewals to revenue.

The author does not leave the matter here, but proffers what he conceives to be the proper method of providing for what he designates "recoupment of capital." Here is the gist of his paper. The recoupment, he suggests, can be made by setting aside a sufficient sum each year, which, if allowed to accumulate at compound interest, will replace the capital expended in a given number of years. The amount to be annually paid into the fund would be a certain percentage of the capital expended in addition to the cost of renewal work. The exact percentage would require very careful consideration; but it should be possible, by equating the relative values and lives of the different parts of the works, to arrive at a period for the total recoupment which might be applied to the whole capital—save capital expended on goodwill or similar objects, which it might be desirable to treat separately and to assign a different term. The proposal contemplates the debiting to the fund of all renewals instead of to revenue; and the amount of capital expended on objects not renewed or renewable should, when the fund matured, be carried to capital account, and the original amount written off. Of course, it would be necessary that the annual payment into the fund should be compulsory; and as renewals are part of the expenditure on revenue account, the fund should be a first charge on the undertaking—that is, before either interest or dividend. The establishment of a fund on the lines indicated would necessitate the division of renewals from repairs; and this is the point discussed in the latter part of the paper—the conclusion arrived at being that it would not be a difficult matter to make a workable division. The distinction, however, between the one and the other should be fixed when the term of the fund is settled. The author does not suggest that he has found the best solution for the problem; but he says, and says emphatically, that there can be no question that some remedy must be found if the industry is to occupy a thoroughly good financial position in the future.

The paper produced a sound and interesting discussion. It was opened with a good controversial point by Mr. R. O. Paterson. He gives an interpretation not commonly accepted to items No. 5, 7, and 8 in the Revenue Account in the Schedule to the Gas-Works Clauses Act, 1871. The first will suffice to give the line of his reasoning. It reads: "Repairs *and maintenance* of works and plant (including *renewals* of retorts), machines, tools, material, and labour." Renewals here is specifically mentioned only in connection with retorts. Now the point Mr. Paterson makes is this: That it is hardly conceivable a gas company working under a regulated monopoly would be allowed by Parliament to set aside an actual amount of cash year by year in the form of a recoupment account, such as the author suggests, for the purposes of redeeming the capital. But he contends, Parliament clearly had in view that any company establishing a gas undertaking under this regulated monopoly should have power to maintain that undertaking. Parliament, indeed, had a great distinction in mind, when it agreed to the terms used in item No. 5 under the head of manufacture of gas—"Repairs and maintenance of works (including renewal of retorts)." Mr. Paterson puts this case: Supposing a gasholder is taken down which has become small and obsolete, Parliament does not say the gasholder shall be renewed. But it does say the works are to be maintained; and if the holder is taken down the gas company must, are called upon to, and are given power to, maintain the works by putting into them in some way the value of the

holder, and it must be done in the revenue account in the form of maintenance. In fine, Mr. Paterson holds that Parliament intends that works shall be maintained at their original capital value. Depreciation funds are only allowed "for works on leasehold lands (if any);" but Mr. Valon's proposed fund, he considers, is only another name for depreciation.

A second good contributor to the discussion was Mr. J. Ferguson Bell. He holds strongly that the putting aside of a certain amount each year to form a renewal fund is sound finance; and one of the features of this year's Parliament has been the giving of permission to gas companies to put on one side a sum for such purpose. Mr. Bell also directed attention, as did subsequent speakers, to the variation in practice that exists as to the payment of income-tax on sums that are ear-marked. On the point as to the granting of renewal funds by Parliament this session, one or two speakers appeared to be unaware of the fact; but later Mr. Webber took an opportunity of pointing out their error in this regard. The method of recouping capital advocated by the author strikes Mr. H. Townsend as being rather complicated. The additional charge would be a burden on the consumers, would be a further obstacle to reduction, and so would make the meeting of competition more difficult. (Mr. Townsend's philosophy seems to be a little at fault here, seeing that, if the proposal prevents the accumulation of unproductive capital, there would be so much less required for dividend.) Mr. W. B. Randall suggests the consideration of the advisability of opening suspense accounts for such things as the re-establishment of gasholders and the repayment of expenses incurred in securing new parliamentary powers. He has a liking for the system of having a separate account for stoves and prepayment fittings, and writing off a sum each year by way of depreciation. Not being tied by Acts of Parliament, the Airdrie (N.B.) Gas Company, which Mr. D. Vass serves, make it a point to write off as much depreciation year by year as they consider the works have depreciated; and if the undertaking then came to the hammer, the sum that would be received would, declares Mr. Vass, be at least the book value. In a like happy position is Mr. C. A. Craven, who has long served the Dewsbury Corporation well. Something like 27 or 28 years ago, his capital charges were 2s. 6d. per 1000 cubic feet; they are now 10d.; and the process of reduction is continuing. His Committee err on the right side, and keep the value of the works "up to the nail."

It strikes Mr. J. Hepworth that Parliament having over and over again refused to allow anything to gas companies in the way of depreciation would not be at all likely to permit anything in the way of recoupment—if Mr. Valon means setting aside certain funds to replace dead capital. But he was not at the moment sure that this is what the author did mean. Under the present condition of things, dead capital can only be provided for by apportioning it to repairs and maintenance. The difficulty in the way of the author's suggestion, in the eyes of Mr. J. P. Leather, is that he proposes that the consumer should find the money for the fund; and he does not think Parliament would allow a gas company to pay their maximum dividends, and put aside this fund in addition. The practice in vogue at Armagh, Mr. Whimster tells us, is to write 2 per cent. depreciation off the present value of the works and plant, 10 per cent. off meters, and 10 per cent. off gas-stoves. His trouble is that each new Surveyor of Taxes who comes along says he cannot allow ordinary repairs and maintenance and this depreciation as well; but he appears to succeed in the end. "The capital of a gas company should be kept as near as possible to the actual structural value of the works" is the rule laid down by Mr. W. Hardie. In this matter, he advocates that the consumers of to-day and those of the future should both be considered, and the fair thing done between them. The consumers of to-day, the President remarked, in closing the discussion, are always providing for the consumers of to-morrow; and he is against imposing a double burden on them. The reply of Mr. Valon ran on the same high level as the discussion. No suggestion, he said, had been made that the existing arrangements are adequate. If fairly and carefully carried out, they do provide for the replacement of plant when it becomes necessary to replace it; but what he had tried to show in the paper is that, when plant becomes obsolete, and is not renewed, then the capital itself ought to be replaced. This amounts, in another way, to the same thing as Mr. Paterson had contended for. The reply would suffer by condensation; and therefore—with the remark that there is plenty of precedent at hand to show that, when Parliament is convinced that existing arrangements are unsatisfactory and inadequate, they are not slow in effecting a change—interested readers must be left for fuller information to the perusal of the complete report.

A New Sulphate of Ammonia Process.

There was rather a thin attendance by the time the paper by Mr. J. Ballantyne, of Hamilton, was reached, although it possessed the merit of presenting something new for discussion. It described, as indicated by the title, a new process for making sulphate of ammonia. Briefly it is termed the "continuous vacuum process." In general arrangement, it is something similar to that of an ordinary continuous plant working under pressure; but it embraces in addition an engine and vacuum pump for keeping the plant under a high vacuum while it is in operation. Apart from its working achievements, its adoption at Hamilton has enabled Mr. Ballantyne to do away with all overhead tanks for liquor and acid, as these can be drawn into the still and saturator from the floor-level, or very little above it. The ammoniacal liquor on its way to the still is first heated in a superheater or economizer by the waste gases of the plant. It then passes into the still at the top, and travels backwards and forwards over steel-plate trays, with baffles on one-half of each tray; the other half containing ½-inch perforations through which the steam and gases rise. The liquor overflows to the next tray by an overflow-pipe dipping into a seal-pot. The pipe is so arranged that the liquor on the tray is about ½ inch deep; and the steam and gases as they ascend through the holes prevent the liquor passing down them, and at the same time bubble through it in a large number of small streams—thus effectually driving off all the free ammonia. This process is continued until the middle of the still is reached, when the liquor passes into the liming chamber, in which is a perforated steam-coil which thoroughly agitates the liquor, causing evolution of the various gases. Leaving the liming chamber, the liquor flows to another series of trays, over the serrated edges of which the liquor passes in its passage; the gases and steam rising between the serrations and the sides of the still. There is another perforated steam-coil in the bottom of the still, which keeps the liquor agitated, and produces sufficient heat for driving off the last traces of ammonia. On leaving the still, the gases pass through a large baffle vessel or trap on the way to the saturator.

The only live steam required for the still is in connection with this trap. To prevent the priming over of the still into the saturator, a small steam-jet is here introduced, which acts like an injector, and blows any liquor which may get into the trap back into the top of the still. The gases are brought down the centre of the cylindrical copper saturator by a lead pipe, from which radiate three or four distributors, placed just above the conical bottom of the saturator. To the bottom of the latter is fixed a discharger, which opens into the saturator by an internal valve, operated by a hand-wheel and pinions from without. When the discharger is full, the internal valve is shut, and that on the side opened. The sulphate is then raked out on to the draining-table; the quantity withdrawn being about 1 cwt. at a time. At Hamilton, it is found that the best salting-point of the saturator is 56° to 57° Twaddel. This, generally described, is the process that Mr. Ballantyne brought before the members; and, of course, several other details will be found in the paper. Just a glance at some of the advantages the author set forth. Labour, he claims, is reduced to a minimum. The whole plant being under vacuum, all the steam necessary for the still may be obtained from the exhaust or other engines in use on the works, so that the only live steam required, with the exception of the small jet referred to, is for the engine of the vacuum pump, and any other pump necessary for working the plant. More than half of the exhaust steam at the Hamilton Gas-Works is required for the still; the temperature of which while working is from 75° to 78° C. at the steam-inlet. Being under vacuum, the liquor boils, and the ammonia is driven off at a considerably lower degree; the lower temperature causing much larger crystals to be formed. The total fuel consumption is only 4 cwt. of coke per ton of sulphate made; and, the plant making from 2 to 2½ tons of sulphate per 24 hours, the extra fuel used in the boiler when the plant is working is from 8 to 10 cwt. per 24 hours. The vacuum on the pump and saturator at Hamilton being from 22 to 24 inches of mercury, and that of the still from 13 to 15 inches, the wear

and tear is expected to be very small. It is anticipated that the copper saturator will last eight to ten years without repairs. It is essential, as the saturator is entirely closed, that acid commercially free from arsenic (which is expensive) should be employed. But a simple, inexpensive method has been devised for using common tower acid by passing the waste gases from the plant through the acid until all the arsenic has been precipitated as a sulphide, which is afterwards filtered out.

Opening the discussion, Mr. J. P. Leather referred to several points. He asked for information as to the strength of the copper with which the saturator is constructed; and he does not think the large crystals produced look so white as small ones. The advantage of the plant, he also remarked, seems to be the economy of fuel; but this can only apply where it is a benefit to put the plant close to the point where the exhaust steam is to be had on the works. Lead saturators properly made last a long time; and Mr. Leather would have thought a copper one would have had a life of more than eight or nine years. The strength of the acid used in the plant, and the quantity used per ton of sulphate made, are points on which Mr. Walter Grafton sought information. Mr. J. Ferguson Bell was privileged to inspect the plant a few months ago; and it then struck him as being rather complicated. Working under a vacuum, there is a saving of fuel; but Mr. Bell fancies this is counterbalanced by other expenses. He can thoroughly recommend overhead saturators, from the point of view of the labour saved. His experience, too, of the life of lead saturators is from eight to ten years; and the lead is then almost of the value of new. Mr. R. G. Shadbolt wondered whether the total yield of sulphate per ton of coal carbonized is any more than that obtained by the ordinary process. Other inquiries were made; and Mr. J. W. Helps ended the discussion by regretting that the author was not in a position to give some comparative figures between his process and the older fashioned type. His own conclusion is that, when the balance is compared on both sides, there will be little, if any saving shown by the new plant. Mr. Ballantyne made a good defence. The thickness of the saturator is ¼ inch. He states that there is a keen demand for his make of sulphate for the West Indies; and for the extra ammonia in the crystals, he gets an extra price. Regarding Mr. Bell's remarks, when that gentleman saw the plant, it was in a crude state. The price of acid alone in different districts prevented, Mr Ballantyne said, the giving of an average cost. In his own district, most makers use pan acid, which costs about 45s. to 50s. With his plant, he uses 144° Twaddel common chamber or tower acid (not diluted in any way), costing 30s. to 35s., so that there is a saving on this item of 15s. a ton. The quantity of acid used is the same as in an ordinary plant. As near as he could say, the make runs out to 30 lbs. of sulphate to the ton of coal carbonized—that is, without taking out the fixed ammonia. In Scotch liquors the fixed ammonia is a very small quantity; and it does not more than pay the expense of taking it out.

This ended the technical work of the first annual meeting; and the general outline shows distinctly that, notwithstanding the small variety of subjects, the proceedings were, on the whole, excellent in quality. Before separating, the members determined to meet in London again next year, and passed a series of votes to the officers from the President to the Secretary and all who had contributed to the success of the meeting. In moving one of the resolutions, Mr. Hepworth took the opportunity of expressing his gratitude to the Institution for having elected him an honorary member. "I think," he added, "it imposes a considerable obligation on me. It may be I cannot render any service to the Institution in the future. But I can, from my position, do something to guard its honour; and that, at all events, is one thing I shall consider it my bounden duty to do, so long as I have the honour of being connected with it." These words were much applauded.

Evening Star Lodge.—The change from the old to the new conditions in the premier organizations of the gas profession has not brought a change in a long-established custom of the Evening Star Lodge. Again, as for many years past, the members invited the members of the Institution of Gas Engineers who are Masons to an emergency meeting (this time at the Hotel Cecil) on the eve of the annual meeting of the last-named body.

SOCIAL EVENTS.

The Excursion to Eastbourne.

The social events officially arranged for the week included a reception by the President and Mrs. Dougall at the Royal Institute of Painters in Water Colours on Tuesday evening. It was a brilliant success. The beautiful rooms were thronged; those present numbering about 300. Charming music discoursed by Signor Bocchi's orchestra, conversation, and inspection of the fine specimens of old and modern artistic work on the walls of the rooms, made the hours pass very pleasantly. The President and Mrs. Dougall, too, were generous in the extreme, and were personally unsparing in ministering to the entertainment of their guests.

Friday was set apart for an excursion to Eastbourne; and with the change from the unpropitious atmospherical conditions of the previous two days, the trip was a huge success. A large party boarded the train at Victoria at 8·45 a.m.; the number being reinforced *en route* and at Eastbourne, so that all told the company reached quite 200, of which not far short of half were ladies. On arriving at Eastbourne the visitors were at once handed little cards, suggesting and inviting them to visit the Gas Company's new offices and show-rooms, which are only about a minute's walk from the station, and situated in Sussex Gardens, Terminus Road. It may at once be said that the success of the visit was very largely due to the Chairman and Directors and officers of the Company. The Chairman (Dr. G. A. Jeffery, J.P.), the Resident Engineer (Mr. John Hammond), and the Secretary (Mr. James S. Garrard) must be specially named in this connection. They were really indefatigable in looking after the comfort and enjoyment of the large party; and previously they had exercised no little influence in, and had given unremitting attention to, the preparations for the occasion.

Never before, we take it, have the new offices of the Company been beleaguered and taken possession of by such a large party at one time as on Friday. At the entrances were Mrs. Hammond and other ladies presenting to each visitor a choice buttonhole; and during the day throughout the town the "trippers" were known by their floral decoration. The reception inside the offices and show-rooms was most cordial. There the party found Dr. Jeffery, his colleagues, the Consulting Engineer (Mr. H. E. Jones), Mr. Garrard, and Mr. Hammond. Very modestly in a little account of the Company and their works which was distributed, Mr. Hammond remarked that the central offices, show-room, and workshops "may not be found unworthy of your inspection." They were found exceptionally worthy. They are extremely well planned for the work and conduct of the business of a Gas Company. This opinion is shared by those present who know from daily experience the requirements. The show-rooms are well fitted with a splendid assortment of articles for enticing the public to extend the use of gas, and to show them how to use it properly. Looking again into Mr. Hammond's informative pamphlet, we find who is immediately responsible for progress in this department. The writer remarks: "The advantages of the new central town offices, show-rooms, and workshops, together with the recent appointment of Mr. James S. Garrard as Secretary—devoting the whole of his time to the courteous introduction of the most up-to-date appliances to the notice of the Eastbourne public—enable the Company to look to the future without fear, confident of holding their own against all competition." Before quitting the offices and show-rooms, the visitors were kindly provided with light refreshments.

The party were then at liberty to enjoy the beauties of the town for upwards of an hour before lunch. The splendid new pier was free to them until noon; and the time spent there and on the parades was delightful after the weather experiences of the two previous days in town. It is a pleasant walk along the front to the Devonshire Park; and there in the Pavilion probably rather more than 200 sat down to luncheon shortly after 12.30. The catering was excellent; and the luncheon was thoroughly enjoyed. There were two toasts after the usual expression of loyalty; the first being "Success to the Eastbourne Gas Company," and the second "Prosperity to the Institution of Gas Engineers." The former was proposed by the President, and the latter by Mr. Farncombe, one of the Directors. To the respective toasts, responses were made by Dr. Jeffrey and the President-Elect (Mr. H. E. Jones). The various speeches were

CENTRAL OFFICES OF THE EASTBOURNE GAS COMPANY.

very happily conceived and expressed. A photograph of the party was subsequently taken; and this was followed by a drive in special brakes to Beachy Head. Tea was served in the Pavilion in Devonshire Park about five o'clock; and in the couple of hours that remained for disposal, a party of Mr. Hammond's colleagues visited the gas-works. Here we cannot do better than reproduce the portion of the pamphlet prepared by the Resident Engineer, in which he deals with the progress of the Company, and generally describes the works.

MR. HAMMOND ON THE EASTBOURNE GAS-WORKS.

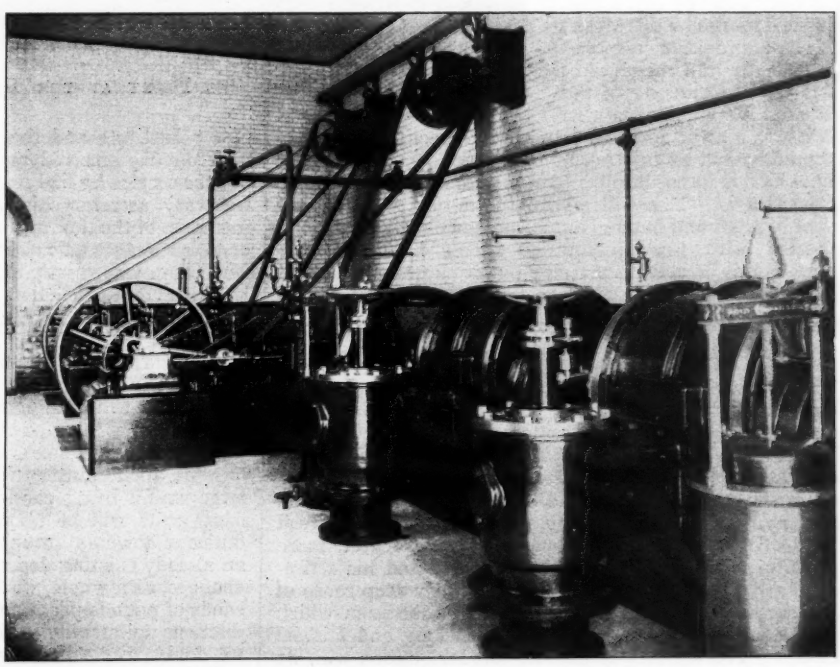
The original works of the Company were first established on a site near the Railway Station in 1852; and it is an interesting fact that, at the first meeting of the promoters of the Company, in March, 1851, there were present Dr. Robert Colgate (who only retired from the Directorate a few months since, the writer regrets to say, through ill-health) and Dr. G. A. Jeffery, who is the present active and genial Chairman of the Company. The late Rev. Thomas Pitman, the worthy Vicar of Eastbourne for over sixty years, with his usual interest in all progressive movements, likewise attended the first meeting, when the capital of the Company was fixed at £3000. A year later, 1852, the first works were built by Messrs. Cutler, under the advice and guidance of Mr. Rutter, of Brighton. The works were continued near the Railway Station up to the year 1868, when new works were built on the present site—two miles out on Pevensey Flats—by Messrs. John Aird and Son, under the guidance of Mr. Alfred Williams, Engineer, and were further extended in 1878; the Chairman at the time being Dr. G. A. Jeffery, and the Secretary and Solicitor, Mr. J. H. Campion Coles.

The business continued to grow; and in 1882—thirty years from the start—the capital had increased to £81,000, with an output of gas at this date equal to 86 millions per annum. But from that time to the present—say, a period of twenty years—the business has made rapid strides coincidently with the development of the town. It is worthy of note, as indicating the progress of the business, that, in the last twenty years, the annual output of gas has risen from 86 millions to 325 millions—say, 276 per cent.; while the capital called up has in the same time only risen 50 per cent. Thanks to the operation of the sliding-scale, the price of gas has been lowered from 4s. to 2s. 10d. per 1000 cubic feet; and a dividend of 14½ per cent. has been paid for years past on the original shares. This, together with the continued development of the business, has caused each issue of fresh capital to command such high prices that the premium capital has risen from £2167 in 1882 to £46,479 in 1902. (Some of the original £10 shares have sold for as much as £35 each, which is equal to a premium of £250 per cent.) In the near future it is hoped with a probable lower cost of coal, further reductions in the price of gas, with correspondingly increased dividends, will be possible.

Mr. H. E. Jones, the Consulting Engineer of the Company for many years past, as is well known, greatly favours a low capital account, with its accompanying advantages of cheap gas supply, in order that consumers and shareholders may alike be benefited by the growing prosperity of the business. The writer here gladly bears testimony to the fact that Mr. Jones has cordially supported him in all his strenuous work of the past seventeen years; and Directors and shareholders are alike to be congratulated on the sound and prosperous condition which the Eastbourne Gas Company has attained.

As to the works, the number of gasholders is four; the capacity of the new and largest one being equal to about 2 million cubic feet. There are two separate retort-houses, containing in all 146 20-ft. through 16-inch by 20-inch ⏛, making a total of 292 mouthpieces. The furnaces for heating the retorts are of the Manager's special construction, with heated secondary air supply. The fuel account is low, working out under 20 per cent.; while the return on residual products is exceedingly good. The retorts, by means of special stopping, are made to last six or seven years; thus greatly adding to the economical and general good working of the manufacturing plant.

In addition to the retort power, there is a first-class water or oil gas installation, of ample capacity to supplement the coal-gas production, which at times in winter now reaches over 1½ millions output per day. The purifiers are of large capacity; some of the boxes being on Mr. H. E. Jones's luteless principle. The coolers. washers, and scrubbing plant have a corresponding capacity. The cost of purifying and materials is low, which is, in a great measure, attributable to the use of the Manager's scheme of

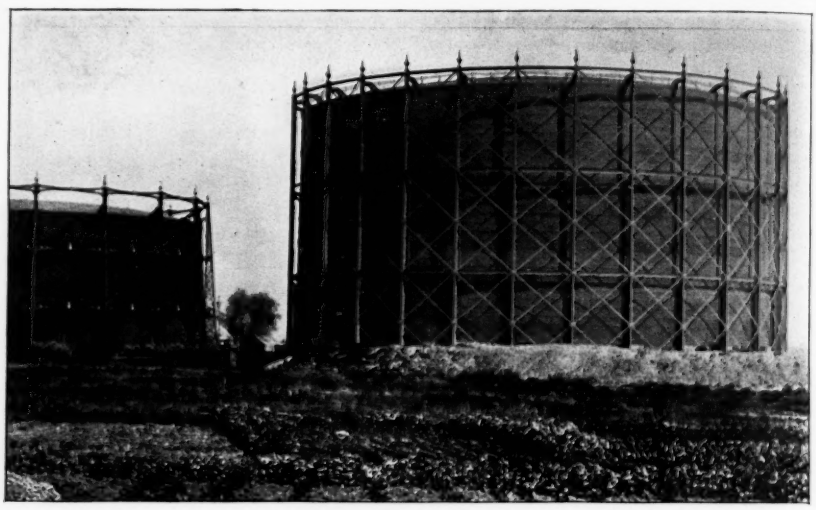


ENGINE-ROOM AT THE EASTBOURNE GAS-WORKS.

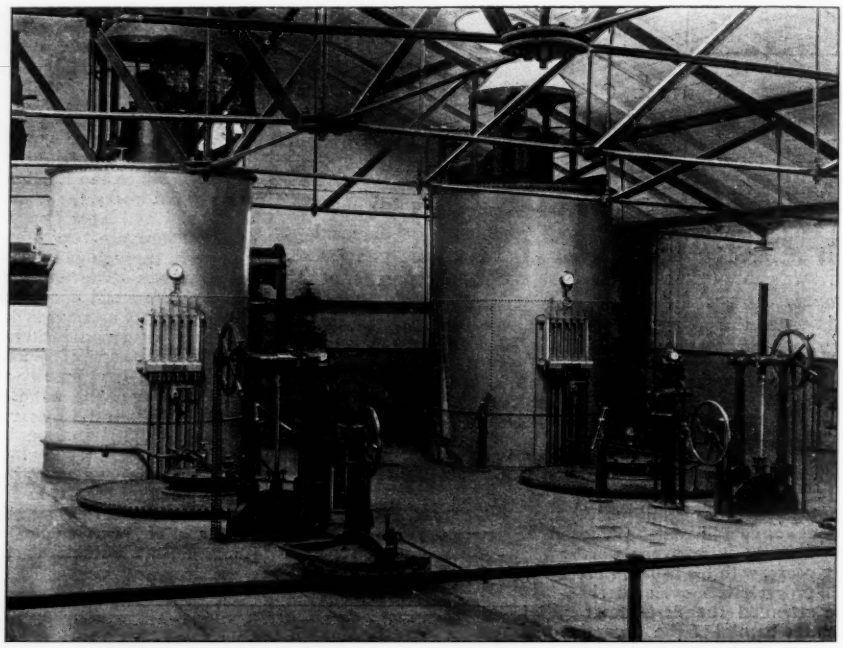
ammonia vaporization in the hydraulic mains, which helps to arrest the gaseous impurity at an early stage in the condensing and cooling plant.

The production of gas last year was 347 million cubic feet; and, in the near future, it is expected there will be a still larger demand for gas. To meet the increase of business, a new 2 million cubic feet gasholder has recently been completed, while there is in course of erection a large meter and governor-house for 30-inch main connections. The distributing plant comprises over 50 miles of street mains, and to these are attached between 6000 and 7000 service-pipes for consumers, as well as supplies to 1300 public lamps. About five years since, slot meters and cookers were introduced into the district; and to-day above 3000 are in use.

The return journey from Eastbourne was made at 7.35; and two hours later Victoria was reached. Safely, it may be said that one and all thoroughly enjoyed the visit.



The New Two-Million Cubic Feet Gasholder at Eastbourne.



Carburetted Water-Gas Plant at the Eastbourne Gas-Works.

The Late Hon. Secretary of the Gas Institute.

At a Meeting of the Council on Tuesday afternoon, the President, on behalf of himself and the Council of the old Gas Institute, presented to Mr. Joseph Davis, who for a long period served the Institute well and faithfully as Honorary Secretary, a beautiful polished oak canteen cabinet, which was handsomely fitted, and bore on a shield the inscription: "Presented to Joseph Davis, Esq., in recognition of his valuable services as Hon. Secretary to the Incorporated Gas Institute, June, 1903." The President referred in appreciative terms to the work done by Mr. Davis during his tenure of the office; and an appropriate response was made by the recipient of this tangible testimony of the gratitude of his colleagues. Mr. T. H. Martin acted as Treasurer in connection with this matter; and he informs us that there is a balance in hand, which is to be devoted to the purchase of a present for Mrs. Davis. This will take the form of a set of silver-backed brushes and hand glass. Another pleasing incident connected with this presentation should be mentioned, though purely a private matter; but it shows the kindly feeling that has existed between the late Hon. Secretary of the Institute and the permanent Secretary. Mr. Dunn on Thursday received from Mr. Davis a letter, acknowledging the service he had rendered him during the period of his honorary secretaryship, and, asking his acceptance, as a memento of the time and of their work together, of a jewelled combination stud, tie clasp, and pin. Coming unexpectedly, Mr. Dunn was greatly delighted with this recognition from his friend and late chief.

RESIGNATION OF MR. FIELD.

The following extract from the minutes of the Court of Directors of the Gaslight and Coke Company, dated the 12th inst., has been sent to us for publication: "Read a letter, dated this day, from Mr. J. W. Field, tendering the resignation, as from September or October next, of his appointment as Secretary and General Manager of the Company." "Resolved—That the Court have received Mr. Field's letter of resignation with much regret, more especially as conditions of health have caused his retirement; and they wish to put on record their deep sense of the energy and devotion to the Company's interests which have been the guiding principles of his long and faithful service." The vacancy created by this resignation will, we understand, be filled up by the appointment of Mr. Henry Rayner, the Assistant Secretary, to be Secretary, and of Mr. David Milne Watson, the Assistant General Manager, to be General Manager.

Previous to this announcement being made, the "Financial Times," writing on the subject, said: "Yielding to the force of circumstances, the Gaslight and Coke Company has set about putting its internal affairs in order. The large staff is being carefully reorganized, and many redundant posts will be abolished. In one case at least, the duties of a whole group of employees will be delegated to an already existing department; and it is expected that the changes, as a whole, will result in a saving of several thousands of pounds per annum. In the matter of pensions, reductions are already in force; and altogether there can be no doubt that the management of the Company's affairs will be more economical in the future. The proposed changes are undoubtedly a step in the right direction."

GENERAL REPORT.

The Annual General Meeting of the Institution was held on Tuesday, Wednesday, and Thursday last week, at the Institution of Mechanical Engineers, Storey's Gate, Westminster—Mr. ANDREW DOUGALL, Jun., the President, in the chair. The attendance was much larger than usual at the meetings of either of the predecessors of the Institution.

CONFIRMATION OF MINUTES.

The minutes of the special statutory meeting, held on the 26th of February, were read, and confirmed.

THE REPORT AND ACCOUNTS.

The SECRETARY (Mr. Walter T. Dunn) then read the notice convening the meeting, and the report of the Council, which was as follows:—

Although it is not possible to present a report relating to the usual period of one year, the amalgamation of the two Societies having only taken place on the 29th of November last, the Council feel that at this, the first annual general meeting of the united Association, a short statement of the work which has occupied their attention since their appointment should be recorded for the information of the members.

It will be seen from the following table that at the date of amalgamation the total membership of the old Institute was 672, and that of the old Institution 239—together, 911; but as there were 67 who belonged both to the Institute and the Institution, the total number became 844.

Class of Membership.	Belonged to both Old Societies.	Old Institute.	Old Institution.	New Institution.
Honorary Members	..	18	1	19
Members	62	520	188	571
Extraordinary members . .	..	28	..	..
Associate members	5	60	..	78
Associates	..	46	38	..
Students	..	..	12	10
Totals	67	672	239	678

Acting in accordance with the instructions contained in the Memorandum and Articles of Association, the Council considered the applications received for admission to the new Society, with the result that the first list of members consists of 678 names. It should be added that of the old Institute there were 113, and of the old Institution 13, who did not apply for membership. Adding the 48 new nominations, which have been passed by the Council, to the 678 resulting from the old membership, the total becomes 726.

With regard to the financial condition of the Institution, reference need only be made to the statement of accounts, copies of which have been issued to the members of the old Institute and Institution respectively, showing that the united Association receives funds from each of the old Societies, after the process of winding up has been carried out in accordance with the resolution of the members.

Now that the preliminary considerations incidental to the formation of the united Society have been dealt with, the Council propose to consider the adoption of some scheme whereby the Institution can be rendered of real practical value to the members, and of benefit to the gas industry generally; and it is hoped that an opportunity will occur during the present meeting of taking some definite steps in this direction.

Appended to the report was the statement of accounts.

The PRESIDENT moved that the report and the statement of accounts, which had been circulated among the members, be received and adopted.

Mr. H. E. JONES (London) seconded the motion; and it was at once carried unanimously.

DECEASED MEMBERS.

The PRESIDENT said, although the Institution had only been in existence a few months, they had already lost two members by death—Mr. R. Ross, of Dungannon, and Mr. H. F. Packham, of Kingston-on-Thames. Probably the last named was best known to most of those present; and an old friend, who had been acquainted with him for nearly forty years, said to him (the President), in announcing his loss, that he had fine qualities, was exceedingly modest and unpretentious, and had a most tender regard for other people's feelings. They would all sympathize very much with the relatives of the two members they had lost.

AWARDS OF PREMIUMS.

The PRESIDENT then presented the premiums awarded by the Council of the Gas Institute. He first called upon Mr. Dugald Clerk, to whom he said the gas industry was much indebted for his original work in connection with the development of the gas-engine. There was a great future for the industry when large gas-engines could be worked with the ease and smoothness of the steam-engine, and at a cost not much greater. He trusted that Mr. Clerk's inventive mind would continue to find successful employment in this direction, and that gas engineers would not be slow to produce cheap gas with which to work engines. It was with great pleasure, therefore, that, on behalf of the late Gas Institute, he presented Mr. Clerk with the President's Medal and a cheque for £10, for his paper read at Southampton on "Large Gas-Engines and the Gases Used by Them." Speaking for the new Institution, he heartily congratulated Mr. Clerk, and ventured to hope that he would long continue his useful work.

Mr. CLERK said he was very pleased to receive the medal; but, if he were allowed, he would return the cheque for any purpose appertaining to the Institution which the President might select.

The PRESIDENT suggested the Benevolent Fund.

Mr. CLERK cordially assented.

The PRESIDENT next presented the second prize of £6 to Mr. John P. Leather, for his paper on "The Valuation of Gas Oils." He said this subject was one of great importance, now that carburetted water gas was so generally used; and Mr. Leather's work in determining the character of such oils was much appreciated. He hoped he would continue his researches, and give the Institution another paper at a future meeting.

Mr. LEATHER having expressed his thanks,

The PRESIDENT presented the third prize of £4 to Mr. R. G. Shadbolt, for his paper on "Sunday Rest for Gas-Workers." He remarked that the masterly way in which the author had brought forward the facts would, he hoped, bear much fruit, and that those who had not yet adopted the cessation of Sunday labour would be induced to do so. It was amazing that, in this Christian country, it should be necessary to discuss the subject at all. Sunday labour was not a necessity; and he hoped all the members would recognize this, and not allow questions of convenience or expense to influence them in breaking the Sabbath day.

Mr. SHADBOLT said he was fully alive to the fact that this award was made more on account of the sympathy which existed between the members of the late Council and their workmen than of the manner in which he had treated the subject. When so many technical papers were read, he scarcely expected such a recognition of his as that he had received; but it was a great satisfaction to him to find that his efforts in connection with this important question had met with approbation.

HONORARY MEMBERS.

The PRESIDENT said the Council had, under the Articles of Association, unanimously nominated five gentlemen for the position of honorary members—Mr. George Bray, Mr. Thomas Fletcher, Mr. Joseph Hepworth, Professor Vivian B. Lewes, and Sir George Livesey. It was quite unnecessary to speak of the services these gentlemen had rendered to the gas industry. Their work was well known to all; and everybody connected with the industry had benefited by what they had done. He would move their election *en bloc*.

Mr. H. E. JONES, in seconding the motion, said it accorded in every way with what was in his mind when suggesting the resolution which had to some extent formed the bridge which had brought them together. The question of whether or not they had, on this happy occasion, very important facts to discuss was not, to his mind, a matter of anxiety. Like old friends who had been long parted, they were full of mutual congratulation, and would perhaps have little taste for more arduous business matters. Taking the list and beginning at the bottom, they found the most distinguished name in the gas world—one who was distinctly a gas engineer. The next name was that of a distinguished chemist, who had done a great deal of work in pointing out the direction in which they might progress in obtaining what was their dearest aspiration in these days—cheap fuel and cheap power. The third name was one which bridged over the division between a distinct professional position and that of promoting the practical side of the industry. No part of a gas plant was more important than that which secured accurate registration. Mr. Hepworth had relinquished his professional position for a more lucrative one of a commercial character; but his work required scientific accuracy, and there was nothing in his present occupation

to make them forget the great services that he had rendered in the past to the technical side of the gas industry. With regard to the other two names, he (Mr. Jones) had always felt how dependent gas managers were, in the great business they had in hand, on those who taught them how to employ gas practically. In this direction, the names of Mr. Sugg, who was already an honorary member, and Mr. George Bray, who had made very great improvements in the ordinary means of burning gas in situations where the light was frequently ruined by bad apparatus, were conspicuous. Mr. Fletcher had produced a greater number of appliances for use in the arts and manufactures of this country in connection with gas than any other manufacturer, or he might say any other ten of them. He had provided tools for all the arts and manufactures, as well as for domestic purposes, of extremely good character. The Council were perfectly unanimous in making these nominations; and he had much pleasure in seconding the motion that the gentlemen named in the list be elected *en bloc*.

Mr. Isaac Carr (Widnes) asked if the list included the whole of the honorary members.

The President said it did not. It was only the list of gentlemen nominated by the Council under the new rules of the Institution.

Mr. W. Smith (Bolton) asked if all traders were to be admitted as honorary members; and, if not, how it was that Mr. Bray and one or two others were to be received and others rejected. He was one of the oldest members of the Association, and remembered very well when the disruption took place, and who had a great deal to do with it. At the first meeting of the new Institution, for Mr. Bray's name to be proposed as an honorary member seemed to him to be a fatal mistake; and he should never vote for anything of the sort. He hoped members would have so much self-respect that, unless traders generally were to be admitted, they would not make an exception in Mr. Bray's favour. He moved, as an amendment, that Mr. Bray be not elected.

Mr. W. Prince (Stoke-upon-Trent) seconded the amendment.

The President said he was very sorry this question had been raised. He had hoped that the hatchet had been buried, and therefore he greatly regretted to find there was this resurrection. However, as the amendment had been moved and seconded, he would put it to the meeting.

Mr. H. E. Jones said the amendment was practically to expunge one name from the list which the Council had unanimously and cordially recommended; and therefore he must appeal to the members to bear in mind how important it was that, now that they had come together, they should be a united body. He did not like quoting Scripture; but really this was an occasion when they might say that "mercy and truth had met together; righteousness and peace had kissed each other." He sincerely hoped they would drop all these small jealousies. The gentlemen whose names were on the list were distinctly those he had in his mind when he thought the Institution would do well to put into a third independent class of honorary members those who had done essential service to the great gas industry. He trusted they would be united; and he would appeal to Mr. Smith not to press his amendment. If he had in his mind any other trader who he thought was equally entitled to be elected an honorary member of the Institution, he had only to send it in, and the Council would consider it.

Mr. Smith said he could not withdraw the amendment, even if he alone voted for it. He did not see why Mr. Bray should have any preferential treatment. Other gentlemen wished to join, no doubt; but they would not have a chance unless they were supported by the Council.

Alderman Miles (Bolton) also appealed to Mr. Smith, as an old friend of long standing, not to persist in the amendment. He (the speaker) had no doubt that Mr. Smith felt strongly on this question; but, for the sake of peace, at the first meeting of the united body, he would earnestly entreat him to withdraw his opposition, and content himself with having made what he doubtless regarded as a righteous protest. He hoped that what had been said would be considered by the Council, and that they would be exceedingly cautious as to whom they admitted, knowing the feelings of many of the members on the subject.

Mr. Smith said if he could accept such an appeal from anybody, it would be from the Mayor of Bolton; but this was a matter of principle with him, and he could not withdraw.

The amendment was then put, and negatived by an overwhelming majority.

Mr. C. E. Jones (Leyton), in supporting the original resolution, said he thought the Council, instead of being at all prodigal in their selection, had been rather too modest. There were many able men of scientific attainments, whose honour was unimpeachable, quite worthy to join the ranks of the honorary members. He hoped that no narrow-mindedness would be shown in this matter.

The resolution was then put to the meeting, and was carried *nem. con.*

Sir George Livesey said he hardly knew what he could say in acknowledging his election. It was nearly forty years since he first attended meetings of the British Association of Gas Managers and its successor; but he never felt in a more embarrassing position. First of all, he must thank from his heart the mover and seconder of the resolution, and the gentlemen who had carried it, for the great honour they had done him in electing him to be an honorary member of the Institution. It was the greatest honour which could be conferred on any man; and he was sure that his fellow honorary members appreciated it as highly as he did. He did not know that he could say much more; but he must add a word or two about Mr. George Bray. But for Mr. Bray, this union could not possibly have taken place; and they were very much indebted to him for the great magnanimity he displayed when he said to the old Institute that he was willing to retire if he were an obstacle to union. It was theirs to command, he said, and his to obey. The union might have taken place years ago so far as Mr. Bray was concerned. As he was not present, he (the speaker) might say that Mr. Bray was a hard hitter, and said hard things; but he was an honest man, and he never made use of the Institute to further his personal objects. He (Sir George) was very glad indeed that Mr. Bray's name was associated with his own in the honorary membership—in fact, it would have taken off the greater part of the pleasure if it had not been. In electing Mr. Bray as an honorary member, the Institution had only done what was right and proper. As for himself, he could say but little. He had been devoted to gas all his life, and had tried to do what he could for the furtherance of the industry. But the work of carrying on this great industry must fall into other hands than those of the men who remembered the old British Association of Gas Managers. That there was a great future for the industry he had no doubt; but he wanted to see young men induced to enter the profession, who would devote their powers to ensuring its prosperity in a way which perhaps had not been done hitherto. For this purpose, it was essential that those who held the purse-strings—the directors of gas companies and the committees of the corporation gas undertakings—should understand that it was necessary, if the industry was to prosper, that they should do their duty, and not act in a parsimonious manner towards men of ability. Ability was wanted badly; and the reason why there was not such a display as might be hoped for, and was seen in the general engineering and electric professions, was that sufficient encouragement was not given. He wished to impress on directors of gas companies and on gas committees of corporations that it rested with them to do their duty in bringing forward young men of ability to further the great industry in which they were engaged. He again thanked the members for the honour they had done him.

Professor Lewes said he could not claim to have such a long experience in gas matters as Sir George Livesey. It was only about fifteen years since he was "discovered" by Mr. Webber, of the "Journal of Gas Lighting;" and it was the encouragement he gave him that led him to turn his attention to matters gaseous. He had found since then so much encouragement from them all, that he had devoted a considerable part of his time to gas; and that morning they had given him his reward by electing him an honorary member of the Institution. He could only say that as long as he lived and could work he hoped he might continue to be of some small use to the industry.

Sir George Livesey said there was just one other matter. He forgot to mention their old friend Mr. Charles Sellers, who, he was sure, would have rejoiced if he had seen the present meeting. Mr. Sellers was the go-between in regard to Mr. Bray and himself; and the members of the Institution were greatly indebted to him for their present united position.

PRESIDENT'S ADDRESS.

The PRESIDENT then delivered his Inaugural Address, which was given in the "JOURNAL" last week (p. 645).

At the close of the address,

The PRESIDENT said he should like to depart from the ordinary course, and invite discussion on the address so far as it bore on the work of the new Institution. He thought they might spend an hour very profitably in considering this subject, if the members thought fit.

Mr. CORBET WOODALL said he felt it to be a pleasure, on this memorable and auspicious day, to be permitted to take any part in the proceedings of the reconstituted Institution, and was proud to have the duty of proposing a vote of thanks to the President for the address he had given. If he might say so respectfully, he thought the President had done wisely in addressing himself less to the various points of technical interest which excited attention at the present time, than to the future of the Institution, and the work which it might be expected to perform. He had given a lead to thought, not only on the part of those actively engaged in the work of the gas industry, but also of those to whom they must look for help in another direction—viz., for funds to carry out such proposals as he had made. Summarizing the points he desired to emphasize, the President had mentioned seven; and out of them at least four were already in operation in one or other of the gas-works of the kingdom. He (the speaker) was glad to refer to the one for inviting suggestions from workmen and officers, and the conferring of rewards when the suggestions were valuable. He knew one works where this practice was adopted; and he was glad to say that in this particular undertaking there was more enthusiasm and liveliness than in any other with which he was acquainted. He was glad to say also that the Gaslight and Coke Company had adopted the idea of creating a class of pupils—inviting applications from men technically well trained who desired to take up the speciality of gas engineering. These young men were paid a salary sufficient to enable them to live without being a burden on their families during their pupilage; and they were enabled to take part in every branch of the industry, both inside and outside the works. In this direction, much might be done to bring forward the class of men they all desired to see rising up in the service. But the matter which he thought most eminently deserving of attention from the Institution was the proposal to establish a technical laboratory. He had himself referred to it more than once at similar meetings. Their technical brethren in France had such a laboratory, where experiments and investigations were made with regard to any matters brought forward of sufficient interest by various members of the Société Technique du Gaz. A laboratory of this kind could not be carried on without the expenditure of considerable funds; but he knew no way in which gas companies and corporation gas committees could better spend money than in the establishment of such a laboratory. It seemed hardly worth while to lay much stress upon the amount of waste that took place when a hundred different people were carrying on in a hundred different places experiments which could be better conducted if they were in the hands of one or two capable men, under proper direction, in such a laboratory as was proposed. The President had suggested that morning one subject for inquiry which would be eminently worthy the devotion of a large amount of time and ability, if there were any hope of success—viz., how they might reduce the illuminating power and at the same time increase the calorific value of the gas supplied. In order to bring about the establishment of a laboratory such as was proposed, he was sure they only needed to approach gas companies generally with the suggestion to find it most readily adopted. There were many unsolved problems that were still almost a disgrace to the industry. The President had pointed out that while they had met there as a gathering of engineers, the point of most interest to-day was not purely engineering but rather in connection with the commercial and developing side of their work. If Mr. Bellamy, the Chairman of the Plymouth Gas Company, were present, he (the speaker) was sure that he would cordially support the recommendation, because he recently made a similar suggestion. Among the simple and common matters calling for attention might be named the avoidance of the offensive smoking of rooms by the use of gas, the adoption of proper ventilation, the circulation of hot water through houses, simpler methods of lighting and extinguishing gas lights without the use of matches, and other matters of this nature. In such there was room for investigation which would be very profitable. He was quite sure that the Medallist of that day, if he would direct his attention to the best method of installing gas-engines with plant suitable for the generation of electricity for comparatively small users, would also be doing a very great service. He would not have ventured on these observations but for the encouragement which the President held out to them to discuss the problems he had brought forward. He would now, however, move that the best thanks of the Institution be given to the President for his address; and he did so with all the more pleasure when he thought what intense gratification it would give to his old friend, Mr. Dougall, of Hull, that his son should be the first and worthy President of the re-united Institution.

Mr. R. G. SHADBOLT (Grantham), in seconding the motion, said there was an old saying: "Sufficient unto the day is the evil thereof;" and there was another one to the effect that with the occasion the man is sure to arise. They had an instance of this that day. It was a unique occasion, combining various forces with one object in the future; and he thought they would agree with him in saying that the President had displayed the true features of a leader, not only by concentrating his forces on one object, but, having done so, by immediately giving them useful employment. The great and vital factor in the successful running of an Institution like theirs was that of equitable and proportional representation in the management; and he thought it was quite right to place first the fostering of local sections which should be worked from the central body, carrying with it as it did representation from every quarter of the country. The President had laid before the members other objects which were perhaps of equally great importance; but, to use Biblical phraseology, he would say they should provide first for the formation of Local Sections working automatically from the centre, and all the other things would be added unto them.

Mr. H. E. JONES supported the resolution. He said last year he had to thank the President of another Institution for one of the most exhaustive addresses connected with scientific research that could be imagined. This year they had to thank the President for a specimen of good literature, showing that, at any rate, the hardships of a gas engineer's position did not debar him from the leisure in which he might pursue culture; for the address was couched in language which he could only call graceful and eloquent, if not glowing. The only hardship which those who followed him had was that he had been careful to suggest everything that could possibly be done for the future of the Institution. It occurred to him (Mr. Jones), as they were invited to discuss the address, that there might perhaps be one method of encouraging the preparation of technical papers involving great research, and it would be the establishment of a fund for giving prizes in the shape rather of medals than of cheques. He thought that a man who had devoted a good deal of time to the study of some subject for the purpose of giving a paper, liked to have it recorded in the shape of a medal, which he could hand down to his children as proof of the appreciation of his work. With this small suggestion, he could only say that he fully concurred in what had fallen from previous speakers.

The motion was then put by Mr. Woodall, and carried by acclamation.

The PRESIDENT remarked that he did not rise to return thanks at the moment, as it occurred to him that there were some present who would like to carry on the discussion a little longer.

Mr. J. P. LEATHER (Burnley) thought they were all very pleased with the address and the suggestions put forward, but they were hardly prepared at the moment to speak about them. Nevertheless, when the President was referring to the question of a technical laboratory and an experimental gas-works, it struck him that perhaps it would be well to utter a word of caution with regard to these matters. He believed the suggestion was a good one, and that much might be done in the direction indicated; but at the same time he did not know that he could quite agree with the proposition in all its fulness, as stated by Mr. Woodall—that the work could be very much better done in such an Institution as theirs than it could possibly be done by a hundred individuals working up and down the country.

Experimental works would be necessarily in one place, a good way from many people who might perhaps be better fitted to undertake some particular line of research than those who were at the head of the works. Some men of very good technical ability and scientific knowledge might be put on the experimental works; but a man who had actually practised at his own works, and had given particular thought to some difficulty that had occurred, might have ideas which he could bring to fruition better if he did the work himself than by making suggestions to those who were operating a hundred miles away. While he did not for a moment say that this experimental laboratory would not do a great deal of good, they must take care lest people should get in the habit of saying: "Oh, they are studying that at the technical laboratory; I do not need to bother about it." There was always this danger in centralization—a danger to which the President referred when he spoke of the amalgamation of the two Societies, and said they must not expect too much to be done by the central body, or even by the central technical laboratory, but that each must see what he could do in his own works. A good deal in this line might be encouraged if they could only get boards of directors or committees to help them. In his own case, they had a very good Chemist. He had a great deal of work to do, because, the works being municipal ones, there was also a Corporation Chemist, the Borough Analyst, and everything else. But the Gas Committee had given him a pretty free hand and plenty of assistance, and had told him that, if he had any research work in view, he was at liberty to conduct it, even though it might not be anything directly profitable or necessary for the carrying on of the gas-works. If this sort of thing were encouraged in all works, it would perhaps be even better than a central laboratory, though this was certainly worth the attention of the Council. Then the question arose as to getting funds for the purpose. In the past there had been a few gas companies who had contributed subscriptions to the Gas Institute; but it was rather difficult to bring a matter of this kind before a committee and say: "There is a Gas Institution; can you give a subscription of five or ten guineas to it?" If there could be some means of determining what a committee should give, it would be an advantage. In the case of the Sulphate of Ammonia Committee, the manufacturers, or a large proportion of them, joined, and paid contributions in proportion to their make. Would it not be possible to get a large number of the gas undertakings to send subscriptions on the same basis for such an object as the experimental gas-works and laboratory? It occurred to him that it might be more feasible than merely asking in an indefinite way for a subscription. If the directors or the committee knew that a great many other people were giving in proportion to their make, they might agree to do the same. They were all greatly obliged to the President for having put the future scope of the work of the Institution so clearly before them; and he trusted the Council would take these matters in hand, and carry many of them to a good conclusion.

Mr. J. W. Helps (Croydon), as one who had given considerable attention to the subject of experimental gas-works, said he had listened with a great deal of interest to the remarks of Mr. Woodall, and to the criticism of them by Mr. Leather; and he must acknowledge that he did not quite appreciate the arguments the latter gentleman had used. He appeared to think there would be a tendency, if a central laboratory were established, to limit the efforts of those who were working in a scientific direction in gas-works all over the country; and he suggested that if, instead of establishing a technical laboratory, they were to get the directors of various gas companies and the gas committees of corporations to provide money for assistants and chemists on their own works, this would be a far better way of getting over the difficulty. He (Mr. Helps) did not at all agree with him. In the first place, a company of ordinary size, producing 100 million cubic feet of gas a year, would only have to subscribe a very small sum—say, £10 per annum—in order to gain a great many of the advantages they could obtain by having a chemist; but if they had to engage a chemist of their own, they would require to spend a great many £10 notes. Again, he did not quite see that the fact of having such a laboratory as the one proposed would in any way prevent chemists doing all they possibly could to help the central laboratory; because it would to a great extent depend upon the investigations of those outside, who would probably send up results to the central laboratory, where, by the aid of the head chemist, they could be regularly tabulated, and reports issued to the members, with the results of the experiments made not only in the central laboratory, but in the various works all over the country. With regard to the manner in which the funds should be obtained, Mr. Leather suggested that it might be done by asking undertakings to subscribe according to the quantity of gas made or coal used. The Southern District Association had had some little experience in this matter. They practically asked for subscriptions to their Naphthalene Investigation Committee somewhat on these lines; and it was a principle that worked extremely well up to a certain point. But when they had to deal with huge concerns like the South Metropolitan or the Gaslight and Coke Company, the Bristol Gas Company, and one or two others, it was almost impossible, because they were asking a sum that was too enormous for a body of directors to look at. Still, he thought this was only a minor difficulty, which could be easily got over. The suggestion of the President was that the Institution should at once take some steps to inquire into the various propositions he had made in regard to what should form the work of the Institution in the future; and, in order to put the matter in a concrete form, he would suggest that it should come from the general body of members to the Council as a request that they should form a Sub-Committee to thoroughly investigate and report upon this subject. They had now, under the rules, taken power to co-opt from outside the Council members who might assist on any Sub-Committee, and who had taken special interest in the subject that the Committee were called upon to discuss. If the members were at this meeting to decide that a request should be made to the Council to form such a Committee, and to co-opt from outside those who would be considered by them to be useful, some direct step would be taken towards doing what they all wished to have done. One speaker had laid a good deal of stress upon the question of offering more premiums and prizes in the form of medals. He could not help thinking that there was wisdom in the multitude of counsellors. There were many who could not be put on the Committee, and who would possibly have very little chance of giving the benefit of their advice on the subject, which he hoped the Institution would discuss; but he did not see why they should not offer a prize of some sort for the best paper embodying a considered scheme for the carrying out of these suggestions. There must be many present who would like to have the opportunity of putting on paper their ideas of a scheme which, in their opinion, would be best for the Institution, so as to give effect to the ideas of the President. He did not care to go into any details on these various matters; but speaking merely from the general point of view, he thought if they could get so far as to come to a decision as to the formation of a Committee, and give the Council direct instructions to go carefully into the subject, they would, at the meeting next year, have the thing in something like form, and with good hope of bringing it to a successful issue before long.

Alderman Miles said he should like to refer to one valuable suggestion in the President's address, though he did it with some hesitation, because it was treading on somewhat delicate ground. Still, it commended itself very forcibly to his mind, though he did not expect all the members would fall in with it. The President said he should be glad to see the chairmen of gas committees and the directors of gas companies attending the annual meetings. He (Alderman Miles) thought it would be a very excellent thing indeed, and commended it most earnestly to the attention of the members, mainly on the ground that the chairmen of these bodies were bound to be brought into contact with the gas engineer, and it was highly important, in his judgment, that these gentlemen should work hand in hand together for the welfare of their various works. He feared there was a little disposition on the part of a great many members to avoid being trammelled by the presence of their chairmen; but he did not think they were wise in entertaining such a feeling. The electrical engineers did not follow their example in this respect; for they gave a very cordial invitation to the chairmen. The consequence was that these gentlemen attended in very large numbers the electrical conferences held from time to time, and it made them take a lively interest in the work of their departments. Further, the carrying out of this idea might assist them in obtaining funds from the various corporations, whence at

present they did not receive a penny. If they adopted this suggestion, he was sure they would never regret it, and gas engineers would be fortified and assisted in all directions, for the good not only of their own works, but of the Institution at large.

Mr. S. MEUNIER (Stockport) supported the suggestion of Alderman Miles. He said some time must elapse before the first item in the President's list could be accomplished—viz., the amalgamation of the various sub-sections; and this was the *crux* of the whole matter. No doubt all the difficulties likely to arise from the other suggestions would be removed when this was accomplished. Mr. Leather had shown that there was likely to be a little difficulty, in his opinion, from the local conditions under which various gas undertakings and works were carried on. But these difficulties could, he thought, be overcome easily enough by the proper carrying out of the first suggestion. When this had been done, and they had an amalgamation of the whole of the present District Associations, with a representative from them on the General Council of the Institution, they would have the finest possible working organization, which would enable them to carry out the various other suggestions, such as the one relating to the laboratory and the experimental works. With regard to the formation of the Council, when once they had obtained these Local Sections, he would draw their attention to a suggestion made by his friend Mr. Anderson, that the Committees of these Sections should form the Council. Pending the getting together of the Local Sections, he certainly thought Mr. Helps's idea a very good one indeed. Something of the kind was necessary. Many proposals were coming forward, and there were a number of things that would have to be done if they were to take the position which an Association such as theirs ought to hold. He might say that, in a small way, they were trying in his county to carry out the idea of the President's first suggestion. They had in connection with the Manchester District Institution four Sub-Sections, each of which formed Committees of their own, with the Chairman a member of the Chief Committee. The work they did was reported to the Chief Committee, and by them to the whole body of the members at their meetings. He thought a scheme of this kind could be carried out in the Institution; and with the men at the head of affairs they now had, they would soon rise to a very high position. He thought the suggestion of Alderman Miles with regard to chairmen attending the meetings of the Institution was a good one; but he would draw attention to a point which he had not mentioned as affecting their electrical brethren. The body Alderman Miles referred to was the Municipal Electrical Association, not the Institution of Electrical Engineers. Now, the Institution of Gas Engineers was not a municipalized Association—it contained representatives from companies; and therefore they were practically an engineering body, more on the lines of the Institution of Civil Engineers and the Institution of Mechanical Engineers. Still, he thought that if members of committees, who were always difficult to deal with, could attend the meetings, hear the discussions which took place, and see the amount of time and thought devoted to various matters to which gas engineers had to give their attention, they would have a much higher appreciation of the position of these gentlemen, and of the necessity for paying them such a remuneration as would enable them to carry out their duties thoroughly, and give them the heart to go into their work to the best advantage to those they represented.

Mr. R. BRUCE ANDERSON (London) said a number of valuable suggestions had been put forward in the President's address, but some of them would evidently require time. One, however, he thought, could be carried out at once, and this was the suggestion of establishing a circulating library. He begged to move that the meeting instruct the Council to take this matter into early consideration.

Mr. C. STAFFORD ELLERY (Bath) asked if Mr. Helps's proposal required a seconder.

Mr. HELPS said he did not move his suggestion as a resolution, being himself a member of the Council. He simply threw it out in the hope that some member would move something to the same effect.

Mr. ELLERY said he would do so, though not because he agreed with all Mr. Helps had said. While it would be an admirable suggestion to have some pre-eminently capable man as a sort of technical adviser to the Institution, he thought the lines along which the Southern District Association were going in their naphthalene inquiry furnished an illustration of what could and should be done. He was rather suspicious himself of the results that came out of laboratories. As some of them knew, analyses were made, and when they tried them in a practical way, they got very different results. He did not know that this needed any illustration. They had all, at one time or another, had to face serious difficulties of the kind; and he felt that—if investigations were being carried on with the thoroughness and exhaustiveness which they knew belonged to laboratory research, and then took up some scheme which was recommended on account of the results, and expected to get in a practical way something like those results themselves—he imagined there would be disappointment to everybody. If they had some scientific man who could go into matters that needed investigation in a practical fashion, in a manner similar to the investigation now being carried on by the Naphthalene Committee, at the gas-works where the conditions were what they would be later on, they would have more confidence in the results. This was a detail for the Committee. As for the proposal to invite the chairmen of committees to attend their meetings, he quite agreed with it. Many points raised by the President in his excellent address would be carried forward if the chairmen of committees could go back from the meetings with their minds filled with the ideas they would receive there. It was one thing to read the report of the discussions, but quite another for a chairman to come and see and hear for himself. He concluded by moving that the Committee he suggested should be appointed.

Mr. H. LEES (Hexham) asked what Committee it was proposed to appoint.

The PRESIDENT said as he understood it was referred to the Council to appoint a Sub-Committee, with power to co-opt members from outside, to take into consideration as soon as possible the suggestions in the address, and possibly others.

Mr. LEES said the discussion itself showed how important it was that the matter should be referred to a Special Committee. The suggestion made by Mr. Meunier, with the best intentions, would very heavily weight the Institution. If the whole of the Committees now composing the District Associations were made the Council of the Institution, they would have something like fifty or sixty members on the Council, which would be quite unworkable. While it was important that, if a District Association became affiliated, they should have some representation, it should not be disproportionate; and there would be a further objection to it, inasmuch as many members of the District Associations were not members of the Institution. These points showed how important it was that the matter should be fully dealt with. He had much pleasure, therefore, in seconding Mr. Ellery's motion.

Mr. D. T. LIVESEY (East Grinstead) suggested to Mr. Ellery that the resolution should run to the effect that it be an instruction to the Council to formulate a scheme, in consultation with the District Associations, for the amalgamation of such Associations as district branches of the Institution, and that the scheme should be presented to the next annual meeting; also that the meeting further instructs the Council to consider how far the suggestions in the President's address can be carried out. He thought it very desirable to have some definite resolution.

Mr. ELLERY said he could not agree with this. They had had some excellent suggestions from the President; and, in order that they might take definite form, and not simply pass into the record in their "Transactions" and be forgotten, he moved that the Council be requested to appoint a Committee, by co-optation or otherwise, before the next meeting, to take these suggestions into consideration and report thereon.

Mr. J. CARTER (Lincoln) said that this simple proposal requested that a certain Committee should embark on a certain investigation. There was no necessity, at the present juncture, for making the resolution too exclusive or too limited. He could not see why they need limit their idea to the suggestions, valuable as they were, contained in the President's address; and he suggested that the resolution might be improved if the words were added "or any other matter of interest or advantage to the gas industry."

Mr. A. BUCKLEY (Holmfirth) had great pleasure in congratulating the President on his able address, three points in which very specially appealed to him: The chairmen of

committees attending their annual meetings; the maintenance of cooking-stoves and gas-engines; and the commercial side of the question.

The PRESIDENT then put the resolution moved by Mr. Ellery, with the addition suggested by Mr. Carter; and it was at once carried unanimously. He then thanked the members very much for the kind way in which they had received his address. It was always a matter of great anxiety to a President to know what to say on such an occasion; but that day there seemed to be only one subject for him, and he was very glad the members had approved of his selection.

THE LECTURE AND PAPERS.

The reading and discussion of papers was then proceeded with. They were taken in the following order:—

Tuesday.—(1) "Photometry and Testing." By WALTER GRAFTON, F.C.S., of London. (2) "The Lewes Process at Tipton." By SIDNEY O. STEPHENSON, of Tipton.

Wednesday.—(3) "Calories and Candles." Lecture by Professor VIVIAN B. LEWES, F.I.C., F.C.S.

Thursday.—(4) "The 'Selas' System of Intensified Gas Lighting both for High and Low Pressures." By F. D. MARSHALL, of Copenhagen. (5) "Later Developments in High-Pressure Lighting." By A. W. ONSLOW, of Woolwich. (6) "High-Pressure Gas Incandescent Lighting." By W. T. SUGG, of Westminster. (7) "Unproductive Capital and its Relation to Renewals." By ARTHUR VALON, of London. (8) "Sulphate of Ammonia Making by a New Process." By J. BALLANTYNE, of Hamilton.

The lecture, the papers read on Tuesday, and the first two of those taken on Thursday, with the discussions thereon, are given in another part of the "JOURNAL." The remaining papers and discussions will be given next week.

THE BENEVOLENT FUND.

The PRESIDENT took the chair at ten o'clock on Wednesday morning, and announced that the first business would be the holding of the annual meeting of the donors and subscribers to the Benevolent Fund.

The minutes of the last annual meeting having been read and confirmed,

The PRESIDENT said it had often been remarked that this meeting was held at a very inconvenient time; and it had therefore been arranged, and laid down in the rules, that for the future it should be the first business on the second day of the annual meeting of the Institution.

The annual report of the Committee of Management and the statement of accounts were taken as read. The Committee stated that there had been four sources of revenue to the fund, resulting in a total sum of £192 6s. 7d. The grants made by the Committee in relief of various cases of distress during the past year amounted to £88 15s. The Committee recorded with great regret the death of Mr. W. R. Chester, who, though only elected as their colleague in the year 1901, had previously taken a very active interest in the Fund. As the result of his special appeal in 1896, donations amounting to upwards of sixty guineas were received. In closing their report, the Committee said they could not but feel that the amalgamation of the two Societies, which had at last been happily accomplished, would have a most beneficial effect on the future of the fund, and would render possible a much larger measure of good work. The accounts showed a balance of £2387 at the credit of the accumulated fund.

Mr. T. H. MARTIN (New Barnet) moved the adoption of the report and accounts, and expressed the hope that many members who had not hitherto subscribed to the fund would now see their way to do so.

Mr. H. E. JONES, in seconding the motion, wished to accentuate the suggestion that they should make this a really substantial fund, so that the Committee might rely on always being able to help those of the profession who might unfortunately be in distress. Mr. Corbet Woodall served with him on the Benevolent Fund of another Institution of which they were members; and he was sure he would agree with him that it was a great source of gratification to them to have sufficient money in hand to deal not only kindly, but liberally, with the cases that came before them. Only a few days previously, a member of the gas industry came before them and was very liberally dealt with, because he happened to belong also to that Institution. He hoped that the fund would be near their hearts all through the meeting, and that in celebrating their happy reunion they would, on their return home, offer a thanksgiving, by sending some subscription, however small, to the fund.

Mr. CORBET WOODALL said it was quite true that, in the Institution to which Mr. Jones had referred, they had a Benevolent Fund which it was a pleasure to administer; and it had been a cause of much regret to him, on more than one occasion, when they had to deal with cases of members of their own branch of the profession, that they had not in their particular circle a fund sufficiently substantial to enable them to deal with these cases. He earnestly hoped that, as the result of the present meeting, they would have a large accession of subscribers to the fund.

The PRESIDENT said that, as the result of the appeal which had been made, there had been already an addition of 33 subscribers, contributing £30 3s. This did not include Mr. Dugald Clerk's donation of £10.

The motion was then put and carried unanimously.

The PRESIDENT said the Committee, in order to conform to the new condition of affairs, had drawn up a fresh set of rules, which had been circulated, and no doubt carefully studied. He did not know whether any member had any remarks to make upon them.

Mr. D. VASS (Airdrie) suggested that a small sum from each member beyond his annual subscription would form a substantial addition to the fund; and he thought this might be considered seriously, now that the whole profession was united in one Society.

The PRESIDENT remarked that the subscriptions to the Benevolent Fund must be voluntary. He did not see how they could be made compulsory.

Mr. H. TOWNSEND (Wakefield) moved the adoption of the new rules.

Mr. J. H. TROUGHTON (Newmarket) seconded the motion, which was carried unanimously.

ELECTION OF TRUSTEES AND COMMITTEE.

Sir George Livesey, Mr. W. J. Warner, and Mr. Thomas Newbigging were unanimously elected to be the Trustees of the fund.

Messrs. T. Berridge (Leamington), A. Dougall (Tunbridge Wells), S. W. Durkin (Southampton), C. Stafford Ellery (Bath), T. H. Martin (New Barnet), and C. Wood (Bradford) were elected the Committee of Management.

This concluded the business.

OFFICE BEARERS AND NEW MEMBERS.

Prior to the mid-day adjournment on Thursday,

The PRESIDENT announced that the Council had unanimously elected Mr. H. E. Jones to the office of President for the ensuing year, and Mr. Charles Wood, of Bradford, to that of Vice-President; Mr. Daniel Irving, of Bristol, becoming the Senior Vice-President. He also mentioned that all the new members proposed [see list below] had been unanimously elected.

MEMBERS.

Allin, J. W., Chorley.
Beck, J., Stamford.
Carr, H. O., Wandsworth.
Donaldson, W. L., Lymm.
Fowler, H., Derby.
Hallaway, J. P., Singapore.
Harrison, H. G., Ashbourne.
Jones, F. H., Epsom.
Jones, S. H., Stepney.
Leaf, M., York.
M'Grath, J., Cork.
MacLeod, A. M., Dawsholm.
Oldfield, F. W., Beverley.
Prentice, F., Ipswich.
Reeson, H. S., London.
Robinson, H. R.. Mossley.
Shepherd, H. R., Brownhills.
Smith, D. R., Epsom.
Terrace, J., Tottenham.
Timmins, H. R., Hindley.

ASSOCIATE MEMBERS.

Baker, H., Reading.
Bingley, J., Bath.
Braddock, R. B., Radcliffe.
Dougall, A., Hull.
Gibson, R. E., Huddersfield.
Grimwood, C. G., Sudbury.
Hammond, W. H., Eastbourne.
Hilton, H., Middleton.
Jones, A. O., West Bromwich.
Jones, W., Dalton-in-Furness.
Lane, A. G., Aylesbury.
Merry, R., Holbeach.
Morton, P. S., Coventry.
Richmond, F. D., Lea Bridge.
Ringham, S., Croydon.
Smith, A. T. Cowper-, Huddersfield.

Transferences.

The following have been transferred from the class of associate members to that of members:—

Bissett, A. W., Sowerby Bridge.	Paterson, J., Redhill.
Caddick, A., Croydon.	Tarratt, F. P., Darlington.
Chandley, S. B., St. Mary Cray.	Valon, Arthur, London.
Hunt, P. C. H., Melbourne.	Wellens, E. J., Hebden Bridge.

The President said Messrs. Lass, Wood, and Drew, and Mr. W. D. Child, of Romford, had been nominated for Auditors; but it was for the members to elect them.

Mr. West proposed the election of these gentlemen.

Mr. Hutchinson seconded the motion, and it was carried unanimously.

Mr. Jones said he had not on this occasion to thank the members for the honour which had been done him, though he was glad to notice the cordial manner in which his name had been received; but he thought it would be unseemly not to acknowledge the honour conferred upon him by his colleagues on the Council in electing him to the office of President. It was a position, in this epoch-making year of their reunion, which would afford gratification to any man; and no one could fail to regard it as a very high distinction. For his own part, he could not help feeling that it was coupled with a very grave—almost a solemn—responsibility. The Institution now starting on its career must take its place among the scientific institutions of the country, representing the great value of the important industry for which they all worked, and which it so worthily and adequately represented. He could not help wishing, when he looked at the gravity of the position, that he were better qualified to discharge its duties; but the Council had selected him, and they and the members must kindly supplement his inefficiency by helping him. He trusted that next year they would come forward to assist the Council, and promote the dignity and welfare of the Institution, with papers dealing with the engineering problems which were special to their calling, and that an earnest effort would be made to sustain the prestige of the Institution which they had met together on this occasion to inaugurate. He thanked his colleagues for the honour conferred upon him, and the members for their kind reception of his election. It would, of course, have been more gratifying if it had been the result of the unanimous vote of the members; but, under the new constitution, this was impossible, and he must be content with matters as they were.

Place of Next Meeting.

At the close of the reading of the papers,

The President said the next business was to consider the place of meeting for 1904. Their President, Mr. Jones, was a London man, and he thought they would do well to meet again in London.

Mr. J. F. Bell (Derby) moved that the meeting next year be held in London.

Mr. R. O. Paterson seconded the motion, which was carried unanimously.

Votes of Thanks.

The President said they could not separate without according a very hearty vote of thanks to the Institution of Mechanical Engineers for their great kindness in placing their beautiful rooms at the disposal of the Institution—a favour which they appreciated all the more because they were not in a position to reciprocate it. The members had had a very pleasant meeting; and he moved a hearty vote of thanks to their hosts for their consideration and kindness.

Mr. Helps seconded the motion, and said he supposed they would scarcely believe him if he said they looked forward to the time when the Institution would have a home of their own.

The motion was carried unanimously.

Mr. T. H. Martin moved a hearty vote of thanks to the President, who they all knew had been working hard for the past seven years to bring about the amalgamation of the two Societies. He (Mr. Martin) had had the pleasure of being associated with him during that time, and he was delighted to know that he was the first President of the new Institution, after all he had done in connection with it. He need not refer again to the admirable address which they all much appreciated. He would only say that he was the worthy son of a worthy sire. The President came from an old gas family; and he was sure they would all wish him long life, health, and happiness.

Mr. Bell had great pleasure in seconding this vote of thanks, which required no words of his to commend it.

The motion was carried by acclamation.

The President thanked the members for the kind and cordial way in which they had expressed their appreciation of his services during the meeting. When he undertook the position of President, he felt there was a considerable amount of hard work before him; but his labours had been made very easy by the cordial way in which the Council had supported him throughout, and also by the manner in which the members had received their work.

Mr. W. S. Morland (Gloucester) proposed a vote of thanks to the Council, and remarked on the large amount of work which had been thrown upon them owing to the amalgamation.

Mr. D. H. Helps (Reading) seconded the motion, and it was carried unanimously.

On the motion of Mr. C. A. Craven (Batley), seconded by Mr. J. P. Leather (Burnley), a vote of thanks was accorded to the Auditors.

Mr. Paterson proposed a vote of thanks to the authors of the papers. He said there could only be one opinion as to the value of these productions; and it augured well for the future prosperity of the Institution that they had had such a successful, well-attended, and hearty meeting.

Mr. Broadberry seconded the motion, which was carried unanimously.

Mr. J. Hepworth (Edinburgh) said he also had to propose a vote of thanks, but before doing so he must ask the indulgence of the meeting for one moment on a personal matter. He was not present on Tuesday morning when the Institution did him the honour of electing him one of its honorary members, and consequently he could not, at the time, express his great appreciation of the honour conferred upon him. He would therefore take this opportunity of saying how grateful he felt. It was an honour which he could not have sought for himself, though he might have sought it for others; and he was the more grateful that the Council had been good enough to confer it upon him. He felt that it imposed a considerable obligation upon him, and though it might be that he could not render any service to the Institution in the future, at all events he could possibly do something to guard its honour, and this he should consider it his bounden duty to do. He begged to propose a hearty vote of thanks to the Honorary Secretary for his services. He thought the Institution was to be congratulated on having Mr. Helps as its Honorary Secretary. They were all old enough to know how much any Institution like theirs depended on the permanent officials. If the Honorary Secretary was not quite one of these, he was very nearly; and in this case he hoped he might be so. The ease, smoothness, and excellence of the work done in such an Institution must depend upon those who were always at the helm; and in Mr. Helps they had one whose great experience in the past could hardly be equalled. He had been Honorary Secretary of two or three Gas Associations; and, above all things, he had that love of work and lack of vanity without which no man need occupy the position of Honorary Secretary.

Mr. Valon seconded the motion, which was carried by acclamation.

Mr. Helps, in responding, said he need not say that what he did for the industry and for the Institution was not so much work as a labour of love. But while their words of kindness were like a celebrated cocoa, grateful and comforting, a more practical expression of their approval would be if they would look round and secure some good papers for next year. If they would do this, not only would it confer a great mark of honour upon him, but would materially diminish the work connected with the office. Before sitting down, he begged to propose a hearty vote of thanks to the Secretary, Mr. Dunn, for the way in which he had carried out his duties. Many of the members had known Mr. Dunn longer than he had, but he had been acquainted with him quite long enough to find out many of his good qualities; and it would not be possible for a Society to have a Secretary more enthusiastic in performing his duties.

Mr. J. M'Gilchrist (Dumbarton) seconded the motion, which was carried unanimously.

Mr. Dunn briefly acknowledged the compliment, and the proceedings terminated.

THE LECTURE.

CANDLES AND CALORIES.

By Professor VIVIAN B. LEWES,
Royal Naval College, Greenwich.

Candles and calories! True types of the past and future of the great gas industry—the dead past in which candle power was everything, the future in which calorific value and price will determine the position gas is to take in competition with other illuminants, not because the calorific value must be high to yield all the illumination required, but because fuel gas offers the widest field for expansion. The altered conditions of gas manufacture, brought about by the happenings of the past ten years, demand an entire rearrangement of our methods of valuation as applied to gas supply. Already in the Committee-rooms of the Houses of Parliament scarcely a Gas Bill now goes through without questions of calorific value arising; and everything points to the probability that before long clauses as to calories as well as candles will add to the terrors of the gas manager's life.

At the present moment, the view taken by the average gas manager is that a standard of calorific value would be a relief after the chaos which law and science have succeeded in producing under the title of candle power. But should clauses as to heating value be accepted without due consideration and greatly extended knowledge, it is to be feared that in years to come gas undertakings may find them a serious hindrance to advancement, by binding them down to processes and qualities of coal which might with advantage be abandoned. My desire this morning is to discuss the problem of heating value in such a way as to show the conclusions we can arrive at from our present knowledge, and the lines on which investigation can most profitably be carried out. For many years to come, it will be impossible to divorce the old from the new; and candle power must remain side by side with calorific value. So that the first thing to be done is to bring them into agreement, and to realize clearly the relation that exists between them.

In some Cantor lectures given last autumn, it was pointed out that, in considering the question of the illuminating value of the gas and its calorific value, it must be apparent to everyone who has studied the question that no definite relation can exist between them. One may take a dozen samples of illuminating gas of the same candle power, each of which will differ from the others in its composition; and as the calorific value is entirely dependent on the composition, it will often be found that two 16-candle gases vary in calorific value to a greater extent than between a 16 and a 15 candle power gas more nearly equal in composition, while these discrepancies are to an enormous extent increased by variations in the method of determining the illuminating value. By adopting, however, a rational process of testing the candle power, and taking the mean of an enormous number of calorific determinations, it is found that an average relation can be obtained which may be taken as the basis for considering this question.

Although scientific gas testing may be said to have been in vogue for 35 years, recent events seem to show that we still stand in sad need of common sense in the application of our knowledge; and when we are gravely informed that the right way of testing the candle power of a gas is to begin by destroying a large percentage of the light that the gas is capable of developing, and measuring the remainder with every detail of scientific accuracy, we feel that we understand what the old metaphor meant by "straining at a gnat and swallowing a camel." It was my intention to go fully into this portion of the question, and to bring before you the results of many long sets of tests showing the importance of recognizing the effect of the standard burner on the quality of the gas to be tested; but Mr. Grafton has dealt with this subject, and it cannot be left in more able hands. I must, however, give briefly my own conclusions on the subject so far as they bear upon the relation between candle power and calorific value.

I may at once say that if the historic method of testing the illuminating value of a gas by burning it at the 5 cubic foot rate in a "London" argand is to be maintained, no relation will be found between the two—save that with a slight fall in heating value a great and varying loss in illuminating value takes place. This is due to the fact that the true calorific value is being obtained for the lower qualities of gas; while their candle power is merely a record of the residuum of light obtainable after improper burning has destroyed a variable proportion of the light-yielding constituents. I say variable advisedly, as a gas which gives an illuminating value of 14 candles when tested by a rational method may give anything from 13 to 11·5 candles when burnt at the 5 cubic foot rate in the "London" argand, according to whether it is a pure coal gas or a diluted gas.

The idea that a parliamentary definition made over thirty years ago must hold good under the altered conditions of to-day seems to me utterly opposed to all common sense. Then we had the "London" argand, the 5 cubic foot rate, candles, and the open bar or box photometer. As far as London is concerned, the candles are gone, the old photometer has passed away, and in their place the Referees have given us the far superior 10-candle lamp and table photometer devised by Mr. Harcourt. No parliamentary sanction seemed necessary for these changes; the Referees were all powerful. Moreover, the 5 cubic foot rate seemed to offer no insurmountable difficulties, as with the table photometer the gas has to be burnt to give a definite light; and the value of the 5 cubic feet is left to arithmetical methods. Yet when it is shown that the "London" argand is only fitted—indeed, only constructed—to develop properly the light from a 16 to 17 candle gas when consumed at the rate of 5 cubic feet per hour, and that with a low illuminating gas an error (not of small fractions of a candle, but of whole candles) may be introduced, a cry of pious horror goes up at the thought of altering the standard.

The fact that the Board of Trade have promised to appoint a Committee to consider the whole question, gives hope for the future. But at present all is chaos. For the purposes of the experiments made for this lecture, I have employed the method of testing illuminating power by burning the gas to a light of 16 candles in the "London" argand and calculating the candle power for 5 cubic feet—a method which, although it does not give quite so high a candle power as can be obtained from specially constructed argands, or from the "London" argand as altered by Mr. Grafton, yet has the advantage of being applicable in every gas-works where photometric apparatus exists, and which is very fairly accurate over a range of from 12 to 17 candle gas.

Before attacking the question of calorific value of coal gas, I think it will help us to consider the heat relations of its constituents, as we shall then more clearly realize the factors that govern the results we obtain. In all the many lectures I have given on the composition of coal gas, I have insisted on the importance of the methane present as yielding not only a part of the light, but in giving size and stability to the flame. When we come to consider the thermal side of the question, one is more than ever impressed with the fact that it is the presence of a considerable percentage of this gas that gives coal gas its pre-eminence as a factor in producing not only light, but heat.

The heat value of a gas may be arrived at either by calculation or by direct experiment. As an example of the first, we may take methane, which will give us a fair idea of the troubles that beset our path. The beautiful work of Andrews, Thomson, Favre, and Silberman has given us the basis upon which all calorific calculations are founded. Burning a unit weight of pure carbon under conditions which ensured the whole of the heat developed being transmitted to water, they found that 8080 unit weights of water could be raised 1° C., and that under the same conditions a unit weight of hydrogen would raise 34,400 units of water 1° C.; hence they ascribed the value of 8080 thermal units to carbon and 34,400 to hydrogen.

When a gas consists of carbon and hydrogen only, it is often considered sufficiently accurate in practical working to determine its percentage composition by weight, and then to multiply the carbon found by 8080 and the hydrogen by 34,400—the sum of the two resultants, divided by 100, being taken as representing the calorific value of it as a fuel. On analysis, we find methane has a composition of 75 per cent. of carbon and 25 per cent. of hydrogen; and

$$\frac{(75 \times 8080) + (25 \times 34{,}400)}{100} = 14{,}660.$$

14,660 would therefore be taken as the calculated calorific value of methane.

Now such a calculation introduces two serious errors: First, in the act of combining heat is either evolved or absorbed; and to break up a chemical substance, it is necessary to expend just as much heat as was evolved during its formation. For many gaseous substances, this is easily arrived at. But for solid and liquid fuels it is an unknown factor; and, consequently, for these all calculations are of very little value. It has been shown over and over again that coals having the same percentage composition, and hence the same calculated calorific value, differ in heat value when examined by a calorimeter. Secondly, the value for carbon has been determined for solid carbon; and even this value varies from the different forms of carbon, and for the same form by different observers. It is evident, however, that the carbon does not exist in the solid form in methane. Consequently, such formulæ introduce errors of totally unknown magnitude, either with solid or liquid fuels, and are often not reliable for gases. Various speculations have been made as to the magnitude of these errors; but nothing of a satisfactory nature can be deduced from them.

How serious the first may be is shown in our previous calculation of the calorific value of methane, of which we know the heat of formation. Calculating, as before, the heating effect of methane, we find that it has a thermal value of 14,660 units. But the heat of formation of the molecule of methane (CH_4) is + 20,414 units; and our value for methane corrected would be—

$$14{,}660 - \frac{20{,}414}{16}$$

or 13,384 thermal units—a number much more nearly approaching that which is obtained as a result of actual experiment.

Taking, now, 13,384 as the pounds of water raised through 1° C. by the complete combustion of one pound of methane, we have to reduce this factor to B.T.U.—*i.e.*, to pounds of water raised 1° Fahr. by the combustion of one cubic foot. In round numbers, 23·5 cubic feet of methane weigh one pound. So that $\frac{13{,}384}{23{\cdot}5} = 596{\cdot}9$ lbs. raised 1° C.; and as a degree of the centigrade scale is $\frac{5}{9}$ths of a degree Fahr., $\frac{596{\cdot}9 \times 9}{5} = 1024{\cdot}2$, which is therefore the gross calorific value in B.T.U. The combustion of the hydrogen in the methane, however, forms water, the conversion of which into vapour renders a certain amount of the heat developed latent; and a deduction for this reduces the figure to 919 B.T.U., which is the net value of this particular sample of gas.

A good example of the confusion created in the lay mind by scientific utterances is to be found in the calorific value of hydrogen. A pound of hydrogen when burnt evolves more heat than a pound of any other known substance; and as a rule this has given rise to the impression that this gas must be the most valuable of all gaseous fuels. The fact is, however, overlooked that it is also the lightest known element, and that it takes no less than 186·5 cubic feet to weigh a pound, so that the heat value of the cubic foot is only 325 B.T.U. gross; while the fact that water is the only product of its combustion, lowers the net value to 272 B.T.U.—a lower duty even than that of the product of the incomplete combustion of carbon (carbon monoxide, which yields 330 B.T.U., both net and gross; there being no water to vaporize, and no heat therefore rendered latent during its combustion).

Taking the main constituents of coal gas and tabulating them according to their calorific value taken in round numbers, we may state them as follows:—

Description of Gas.	Calories per Cubic Foot.		B.T.U.'s per Cubic Foot.	
	Gross.	Net.	Gross.	Net.
Benzene vapour . .	938·9	902·5	3718	3574
Ethylene	404·8	381·3	1603	1510
Methane	258·6	232·0	1024	919
Carbon monoxide .	83·3	83·3	330	330
Hydrogen	82·0	68·7	325	272

Taking, now, an ordinary sample of 16-candle power coal gas as supplied to the City, and applying these values to its combustible constituents, we have:

Hydrogen	54 per cent.	×	325	= 17,550
Methane	34 ,,	×	1024	= 34,816
Ethylene	3 ,,	×	1603	= 4,809
Benzene	1 ,,	×	3718	= 3,718
Carbon monoxide . . .	6 ,,	×	330	= 1,980
				62,873

or 628·73 B.T.U. gross for a cubic foot; while if the calorific value be tested direct in the calorimeter, we obtain, as the value of the mean of ten determinations by the Junkers calorimeter, 157 calories per cubic foot, or 157 × 3·968 = 623 B.T.U.

For every reason the experimental determination of the calorific value of a gas is the most satisfactory, the easiest, and most reliable method, as calculation necessitates an accurate analysis of the gas which is very difficult to obtain, and which would not only make the calculation of the calorific value a most laborious operation, but would also leave loopholes for so many sources of error that the results would be open to grave doubt. Given a good analysis, however, calculation enables one not only to obtain the calorific value under conditions where direct determination would be impossible, but also affords us an insight into the cause of any abnormal variation in thermal value which might otherwise be difficult to trace. Taking the calculation of the calorific value just given, it is clear that more than two-thirds of its heating power are due to the hydrocarbons present in it, and that methane is the factor which makes a good coal gas so superior to all other forms of gaseous fuel.

The possibility of directly determining the calorific value of a combustible gas has only been placed within the reach of the gas manager during the past ten years by the introduction of that beautiful instrument that we all know as the Junkers calorimeter, and which has been so often brought before you as to need no fresh description from me. In this instrument, the heat generated by a flame is transmitted to water; measurement of the gas burned, and the volume and rise of temperature in the water giving all the data necessary to calculate the calorific value of the gas. The ease, rapidity, and accuracy with which determinations of thermal value in gases could be made by this apparatus have in reality created the possibility of a practical standard of heat value; and, as was to be expected, a rival calorimeter has appeared on the market in a modification of the Junkers apparatus known as the Simmance-Abady calorimeter.

I have frequently been asked as to the relative accuracy of the two forms of apparatus; and in order to provide an answer to the query, I have had long series of tests made by independent observers working alternately with the two instruments on the same gas, and find that the differences in results obtained from the two forms of apparatus are not greater than the differences obtained between tests on the same apparatus. So that, in practical working, there is nothing to choose between them. I may, however, warn intending users as to the importance of seeing that the thermometers supplied are carefully checked for uniformity over the range of temperature at which they are likely to be used, as a very small discrepancy in the calibration will introduce a serious error into the results.

A point also on which considerable confusion seems to exist in the lay mind is the relation between the calorie and the British thermal unit. For all scientific work the metric system of weights and measures is employed; and the calorie represents the amount of heat required to raise 1 litre (1000 grammes, or 1 kilogramme) of water 1° C. So that when the statement is made that a gas has a calorific value of 157 calories per cubic foot, it means that, on complete combustion, it yields enough heat to raise 157 litres or kilogrammes of water through 1° C.

The unit of heat used in English commercial work is, however, the British thermal unit, which is the quantity of heat required to raise 1 lb. of distilled water through 1° Fahr.; and a factor can easily be found for converting the one unit into the other. The kilogramme is equal to 2·2 lbs.; while the degree on the Fahrenheit scale is equal to 9-5ths of a degree centigrade. So that 1 calorie equals $\frac{2{\cdot}2 \times 9}{5} = 3{\cdot}96$ B.T.U. Therefore, calories multiplied by 3·96 become British thermal units; while the latter, divided by 3·96, give calories per cubic foot. For ordinary conversion work, however, it is often considered sufficiently

accurate to multiply the calorie by 4 to obtain the British value.

Having now cleared the ground, we can return to the question of the relation existing between the illuminating and calorific value, and the points to be considered in the future in defining a calorific limit to a coal gas supply. If the same coal be used for all tests, and varying illuminating powers be obtained by varying the temperature at which the coal is carbonized, fairly concordant results will be obtained —that is, the loss in calorific value will fairly well follow the loss in illuminating value. But directly another kind of coal is employed, a wide divergence from the previous results is found, and analysis at once shows that this is due to variations in the proportions of hydrocarbons present. In the same way, if carburetted water gas made with the same grade of oil is tested, and the illuminating power varied by altering the amount of oil cracked, perfectly regular results are obtained down to a certain limit, below which the illuminating value decreases far more rapidly than the calorific value. But change the oil, and use American instead of Russian, or *vice versâ*, and at once a different ratio is obtained.

It is clear from this that it is not possible to take a calorific value as indicative of any particular illuminating value, or say that such a candle power gas will have a definite calorific value, because a 16-candle gas may be anything between 575 and 650 B.T.U. gross, and will vary between such limits according to the kind of coal used for its production, or whether it is a pure coal gas or a mixture with carburetted water gas. In fact, every alteration in composition is reflected in the calorific value. As, however, calorific tests made on varying grades of coal gas are collected in greater and greater numbers, and are entered in diagrammatic form, the more nearly does a line drawn through the centre of the myriad points approximate to a straight line, until now, after several years testing the calorific value of various grades of coal gas from every part of the country, and made from all sorts and classes of coal, and treating them as described, I have obtained the average relation shown for coal gas, and also the second curve for carburetted water gas.

Taking the original diagram, the lines appear to run through a haze of spots, somewhat resembling a chart of the Milky Way, and which are only rendered straight by their equidistance from outlying points; while those points distant from the main average lines themselves again fall into secondary lines in the same direction, but on different planes to the main lines, and which represent the curves of calorific value for coals of the same kind. I want it clearly understood that this diagram is merely put forward as the average relation between the illuminating power of a pure coal gas and its calorific power, and that the variations from the line may amount to 5 per cent., or even more. But with this reservation, it gives a definite idea of the relation existing between candle power and calorific value.

Taking, now, the chart, our average calorific value may be tabulated for each candle power between 12 and 20 as follows:—

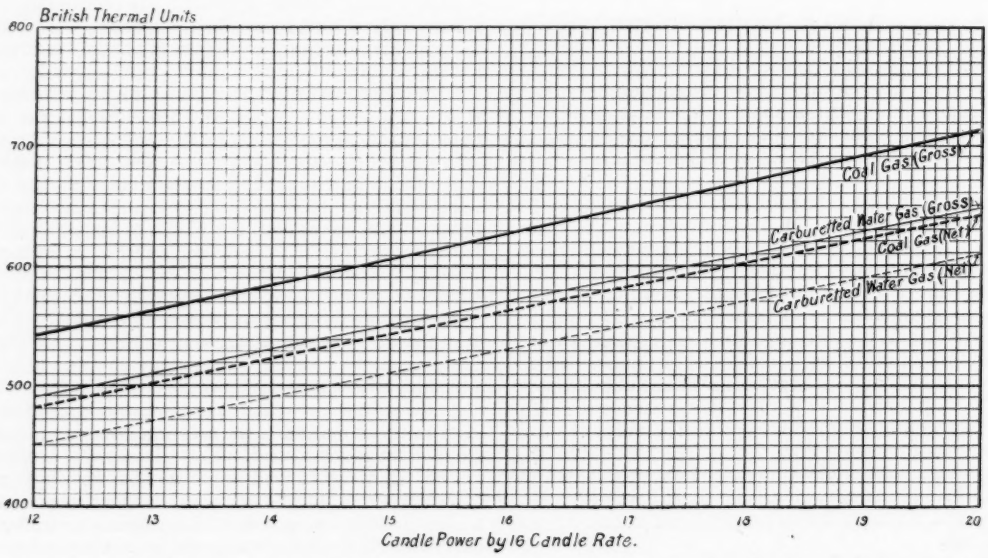
Calorific Value of Pure Coal Gas.

Candle Power.	Calories.		British Thermal Units.	
	Gross.	Net.	Gross.	Net.
12	136·0	120·6	5 0	480
13	141·0	125·6	560	500
14	147·0	131·2	585	522
15	153·2	136·2	6 0	542
16	157·0	141·2	625	562
17	162·5	146·2	647	582
18	168·3	151·2	670	603
19	173·3	156·3	690	622
20	178·8	161·3	712	642

Calorific Value of Carburetted Water Gas.

Candle Power.	Calories.		British Thermal Units.	
	Gross.	Net.	Gross.	Net.
12	123·1	113·5	490	452
13	128·1	118·6	510	472
14	132·9	122·8	529	489
15	137·4	127·6	547	508
16	142·4	132·4	567	527
17	147·5	137·4	587	547
18	152·7	142·4	607	567
19	157·5	147·5	627	587
20	162·5	152·5	647	607

This gives us a basis upon which it is possible to go in the event of it being desirable to define calorific value, as well as candle power, in a Gas Act. If, for instance, a gas company desire to supply a 12-candle gas, and the authorities on their side want the calorific value prescribed as well as the candle power, a margin of at least 5 per cent. from the average recorded calorific value should be taken. That is to say, the gas should be prescribed of 12-candle power and not less than 500 B.T.U. gross heating value; while if the manager desired to largely utilize dilution with water gas, then the standard calorific value would have to be lowered, and the gas prescribed as of 12-candle power and not less than 460 B.T.U. gross heating value—such definition leaving a margin of 5 per cent., which appears necessary in our present state of knowledge.



I should like to point out here that a most important piece of research work remains to be done with regard to the calorific value of coal gas, and that is the tabulation of the calorific value of the gas obtained from various grades of coal. Should any works that are blessed with a complete experimental equipment find it possible to do this, the data will be of the utmost value in the near future when this question must be dealt with.

In many of the published results regarding the relation between calorific power and illuminating power, the experiments have been rendered useless by the low illuminating power having been obtained by "stripping" the gas—*i.e.*, by taking out the unsaturated hydrocarbons to a greater or less extent by bubbling the gas through petroleum. It is

possible, working in this way, to obtain a gas which will remain almost constant in calorific value, while the illuminating power descends with great rapidity. This result is due to the fact that the methane, which gives considerably more than half the heating value, remains untouched, while the benzene and ethylene, which were the main factors in the illuminating value, alone are withdrawn; and these representing only a very small percentage of the heat-giving constituents of the gas, the loss is naturally a very slight one as regards the calorific value.

This point also shows the effect which various methods of enrichment have upon calorific value. If the candle power of a pure coal gas rises, it is because a larger percentage of illuminants from the coal are present, and at the same time that one gets an increase in the unsaturated hydrocarbons, and a consequent increase in light, a *pro rata* increase is also obtained in the saturated hydrocarbons—such as methane—and consequently a relative increase in the heating value. But if a poor coal gas be enriched by adding to it (say) benzol vapour, the enrichment in candle power takes place without so great an enrichment in heating value. This is at once seen when one considers the relation between the light-yielding and the calorific values of such hydrocarbons as are present in the coal gas.

Description of Gas.	B.T.U.'s.		Illuminating Value per 5 Cubic Feet	B.T.U. per Candle.
	Gross	Net.		
Methane	1024	919	5·2	984·6
Ethylene	1603	1510	70·0	114·6
Benzene vapour . .	3718	3574	820·0	22·6

It is clear from this that if a coal gas is taken in which a large proportion of the illuminating power is due to the presence of methane and ethylene, for any given illuminating power it must have a higher calorific value than when the illuminating power is due to the addition of benzene vapour.

It is impossible to leave the question of candle power and calorific value without some reference to the value of the thermal power to the consumer. It was the incandescent mantle that led to reduction in illuminating power in the gas; and the relation between the calorific value of a gas and the light to be obtained from it by the mantle is therefore a question of the utmost importance. In the Cantor lectures given last autumn, I pointed out the fallacy of supposing that a regular fall in the light to be obtained from a mantle takes place with the fall in the calorific value of the gas; and as this seems to have created some dissatisfaction in the minds of those who supported the idea that high candle and high calorific value means increased efficiency in the mantle, I should like to say a few more words in explanation.

The light emitted by an incandescent mantle is partly due to catalytic action taking place upon its surface, and also largely due to the temperature of the flame which is heating the mantle. The popular idea seems to be that the temperature of the flame is governed by the calorific value of the gas. This, however, is an utter fallacy. The calorific value of a gas represents the total amount of heat which the complete combustion of the gas can yield; but the temperature of the flame produced by the combustion will depend: (1) Upon the time in which this volume of gas is consumed; (2) on the area in which the combustion takes place; and (3) upon the amount of air needed for completing the combustion and the specific heats of the products of combustion of the flame and the residual nitrogen from the air, which in their escape remove heat from the flame. It is clear that if a cubic foot of gas contains (say) 500 B.T.U., while another contains only half that quantity, if twice the volume of the second can be burnt in the same time and space, the two flames will probably be about the same temperature. In arguing upon the effect of the calorific value upon the light emitted by the mantle, it seems to have been generally overlooked that it is the intensity of the flame which will be the important factor, and not the calorific value of the gas employed.

I pointed out in my Cantor lectures that I had obtained over 19 candles per cubic foot with water gas; and I thought that as burners had been advertised as giving 20 candles a foot with this combustible, it was a well recognized fact that a high candle power could be obtained. But to my surprise, I received many communications to the effect that no such duty was attainable. This caused me to go again into the matter. I procured a number of Strache and other water-gas burners from abroad; and, through the courtesy of Mr. Goulden, a holder of water gas was placed at my disposal at Beckton. From none of these burners, however, could I obtain a higher result than about 15 candles per cubic foot. But in looking through my old burners, I found the one with which the original tests had been made. This was a fuel-gas burner hailing from Philadelphia, and which, as far as looks went, was practically identical with those of Continental make, but with a little better finish and cleaner holes. With this burner, as the mean of tests with a "C" Welsbach mantle in four positions, 19·38 candles per cubic foot of gas consumed were obtained; the mean of four readings being 158 candles for a consumption of 8·15 cubic feet of water gas at a pressure of 1·3 inches. The chimney employed was 5 inches by 2 inches, which gave better results than a longer one; it being evident that under these conditions one got just the right air supply.

The water gas was purified from carbon dioxide, and had a calorific value of 81·86 calories gross, and 74·66 net. In this case, one has a gas of 81·86 calories, or 325·7 B.T.U., giving the same light per cubic foot of gas consumed as under the ordinary conditions with a "C" Welsbach burner it would give with a good coal gas having a thermal value of 630 B.T.U. It is clear, therefore, that calorific value for this purpose is not so important a factor as some people would have us suppose.

Coming to the question of flame temperature, one finds that the coal gas gives a flame the temperature of which will be somewhere about 1660° C.; while the temperature of the water-gas flame, according to the determinations made by Herr Blass, approximates to 1775° C. The explanation of the higher temperature of this flame is that, in the first place, a much larger volume of water gas than coal gas could be burnt in the same space, and that the gas, being non-luminous, the air supply can be entirely obtained from exterior sources, and is less in volume than with coal gas. Under these conditions, the residual nitrogen of the air and the products of combustion, in their escape from the flame, are probably not heated to so high a temperature as when the larger proportion of air necessary with coal gas is passed into the bunsen burner with the gas, and therefore passes through the whole body of the flame.

The ordinary "C" burner and mantle would require just upon 4 cubic feet of a gas having a calorific value of 630 B.T.U. in order to yield the best results; while in this experiment just double the quantity of gas was consumed. The light also is nearly double; this being due to the well-known fact that the conversion of heat into light becomes enormously greater the higher the temperature. A still more striking illustration of the fact that high calorific values are not necessary for the incandescent mantle is that it is found possible to use gases of even lower calorific value than water gas. It has been universally considered impossible to utilize such fuel gases as those produced by the Wilson, Mond, Dowson, and other processes of the same character for illumination by means of the incandescent mantle, owing to the low thermal value of the gas and the comparatively low temperature of the flame.

It is evident that from one-half to two-thirds of the volume of fuel gases being composed of inert nitrogen and carbon dioxide, the combustible constituents are not only diluted, but the diluents also retard combustion by keeping away the air to a certain extent from the burning gas; and the flame produced is large and of low intensity. With such gases, the idea that further dilution with air could in any way increase the intensity of combustion in the flame to a degree that would render it practically useful for mantle lighting and heating by small flames never seems to have been entertained until Messrs. Tatham and Chamberlain discovered that, by taking an atmospheric burner of special construction with a carefully regulated air supply, the combustion could be so intensified that gases of low calorific value could be utilized for purposes that up to that time had been considered as being only attainable by the use of coal gas.

In testing this process, the gas was made by the injection of air and steam into a producer, in which the fuel used was anthracite nuts. Two samples of the gas taken during

the lighting and heating tests gave me on analysis the following results:—

		I.	II.
Combustibles	Carbon monoxide	29·22 per cent.	28·76 per cent.
	Hydrogen	25·95 ,,	26·37 ,,
	Methane	1·39 ,,	1·97 ,,
Non-combustible	Nitrogen	39·33 ,,	38·92 ,,
	Carbon dioxide	4·11 ,,	3·98 ,,
	Oxygen	nil ,,	nil ,,
		100·00 ,,	100·00 ,,

These analyses show the gas to be of exceptionally good quality. This is borne out by the calorific value; the mean of a long series of determinations made by the Junkers calorimeter giving the calorific value as 198·5 B.T.U. gross, and 184·3 B.T.U. net.

This gas was burnt in the Tatham burner fitted with an ordinary Welsbach "C" mantle; and in the first burner tried gave the following results:—

Gas Pressure, Inches.	Gas Consumed per Hour, Cubic Feet.	Light, Candles.	Candles per Cubic Foot.
2·0	22·5	80·0	3·55

With a second burner, with outside mantle support instead of rod, these results were very much increased; and I obtained:—

Gas Pressure, Inches.	Gas Consumed per Hour, Cubic Feet.	Light, Candles.	Candles per Cubic Foot.
2·0	30·0	150·0	5·0

One of the factors which has led to the many discrepancies in the light ascribed to incandescent mantles is to be found in the difficulty of comparing upon the disc the greenish-white light from the mantle with the yellowish-orange light from the standard; and a distinct advance has been made in mantle photometry by the introduction by Messrs. Simmance and Abady of a form of photometer which eliminates this trouble.

In the ordinary process of photometry, the two lights fall upon opposite sides of the disc. One side shows a distinct greenish tint, while the other shows an equally distinct orange; and it is only with very long practice that the eye gets sufficiently trained to obtain an equalization of light, with the result that there are only a very few photometrists in the country whose results on a mantle I should have confidence in. It has been found, however, that if the disc be illuminated on one side only by the two lights, both falling on the same spot, and they are alternately screened by a rapidly-moving shield, the eye fails to distinguish the two colours, and takes note of the illumination only. So that while the lights are unequal, a flickering sensation is produced upon the retina; but as soon as equality of illumination from the two lights is secured, the flickering ceases, and the spot on the disc becomes steadily illuminated with a greyish light built up of the two colours.

In the new photometer, this principle is applied to what is primarily a Harcourt table photometer, in which the pentane lamp is displaced by the burner taking the incandescent mantle; while in the place of the "London" argand, is an argand the gas supply of which is governed by a micrometer clock. The light from the incandescent mantle and from the argand both fall on the photoped in the ordinary way, and behind this is fitted a rapidly-moving shutter, which alternately cuts off the light from the two sources, and which is driven by a small electric attachment. In making a test, the observer starts the electric motor and regulates the gas supply of the argand burner until the cessation of flickering on the disc indicates that the light from the standard is equal to that from the mantle; and he then determines the actual power of the argand which has been used as the standard by directly comparing it with a 1-candle pentane lamp fitted to a photometer bar in line with the argand, which is so arranged that the two operations can be conducted without the observer leaving his seat.

It seemed to me that this new departure is so important, having regard to the progress made by the incandescent mantle, that I instituted a series of tests with it in order to see how results obtained by a practised mantle photometrist on the open bar would agree with the results obtained by another observer on the new photometer. In order to carry out these tests, Messrs. Alexander Wright and Co. fitted one of the photometers for me in a darkened room at Greenwich; and an open bar photometer with a 10-candle standard was placed in line with the incandescent mantle on the table photometer, so that direct results on the bar could be made at the same time as the readings on the "Flicker" photometer.

In making these tests, I did not confine myself to the ordinary Welsbach mantle, but used several kinds of mantle giving different tints of light—such as the old red chrome alumina "Sunlight" mantle, with its rich orange light, Continental fuel-gas mantles, with that indescribable greenish glare which characterized the early Welsbach mantles, and with ramie, collodion, and cotton mantles of English and foreign manufacture—and obtained the results given in the following table:—

Comparison of Various Mantles—Simultaneous Tests by the Simmance-Abady "Flicker" Photometer and the Bar Photometer.

Mantle.	Photometer. Bar.	Photometer. "Flicker."	Photometer. Bar.	Photometer. "Flicker."
Observer	I.	II.	II.	I.
Pink Sunlight	32·0	36·0	31·0	30 8
	31·0	30·0	28·5	34·4
	33·0	34·4	28·5	32·8
	32·0	30·0	28·0	31·6
	32·0	32·6	29·0	32·4
Collodion	86·0	84·0	81·0	78·0
	86·0	80·0	83·0	78·0
	85·0	82·0	85·0	80·0
	86·0	82·0	86·0	78·0
	85·75	82·0	83·75	78·5
Ramie "Crown"	70·0	65·0	69·0	62·0
	70·0	65·0	72·0	64·0
	70·0	66·0	71·0	64·0
	70·0	68·0	70·0	62·0
	70·0	66·0	70·5	63·0
German Water-Gas Mantle	65·0	62·0	65·0	61·0
	66·0	64·0	66·0	61·0
	65·0	62·0	66·0	61·0
	65·0	61·0	66·0	61·0
	65·25	62·25	65·75	61·0
Ordinary "C" Welsbach	66·0	67·0	67·0	66·0
	66·0	67·0	68·0	64·0
	68·0	69·0	67·0	64·0
	67·0	67·0	68·0	64·0
	66·75	67·5	67·5	64·5

It is clear from these tests that this form of the "Flicker" photometer is not only a very distinct advance on the means at our disposal for determining the light of incandescent mantles by doing away with the personal error, which must always be a very great one with two lights of unequal colour, but also that the results given by it are practically identical with those obtained on the bar photometer; the discrepancies apparent in some of the tests being due to the vagaries of the 1-candle pentane unit, which is utilized for standardizing the argand. Messrs. Simmance and Abady tell me they have now successfully applied the principle to the open bar photometer, so that the 1-candle unit can be replaced by the ordinary 10-candle lamp, which will remove the only objection that I can see to the general introduction of this form of photometer.

In conclusion, I can only hope that this lecture may not have been wearying owing to the necessarily dry details regarding calorific value, and that it may be found of practical utility in the future when the question of calorific value comes to be fought out in the Committee-rooms of the Houses of Parliament.

The PRESIDENT said the members had, no doubt, all come expecting a brilliant lecture; and their expectation had been more than realized. The subject was one of very great importance at the present time; and Professor Lewes had given them a great deal of information which would be most useful. He had also, by the wonderful power he possessed, roused their attention; and he was sure they would apply to great advantage the information they had received.

Mr. W. KING (Liverpool) said it was with very great pleasure that he rose to propose that the best thanks of the meeting be given to Professor Lewes for the important, instructive, and most brilliant lecture with which he had favoured them. Without disparagement to other gentlemen of ability who had from time to time addressed the old

Associations, he could safely say there was no one to whom they listened with so much pleasure and edification as to Professor Lewes. They must all envy him his marvellous powers of memory, and the wonderful art of concealing art. He interested them in what he called dry details, which, however, did not appear dry from his lips; and they must envy him that power, and rejoice to be able to listen to a gentleman who could treat these matters in so instructive, brilliant, and entertaining a manner.

Mr. W. A. Valon (London), in seconding the motion, said he need add nothing to the remarks of Mr. King. The name of Professor Lewes was a household word among the gas profession. Whenever they heard that a lecture was to be delivered by him, their state of mind was in the first instance one of expectation; and they were never disappointed in the result. He had the power of gathering round what would otherwise be dry details a beauty of description which amounted almost to fascination; and they also found at the close the great satisfaction that they had learned from him something they had not known before.

The motion having been carried by acclamation,

Professor Lewes, in reply, said although a good deal of the matter he had brought before the meeting was excessively elementary, still he thought much of it was of great importance to the gas world in the future. There was one point especially he should like to bring out. There was a vast field at the present moment for a most important bit of research work. Any gentlemen who had the good fortune to have extremely efficient plants in their works, would be conferring a very great benefit on the gas industry if they would take the various grades of coal—coals from the various fields—and determine the relationship existing between the thermal value of those coals. There had been plenty of work done on the different values of coals in respect of their gas-yielding properties, and factors of that character, but none on the calorific value of the gas obtained from distinct and separate classes of coal. There was such a wide difference between gas produced from North Staffordshire and Durham coal, that he imagined they would find a good deal of food for thought if such experiments could be carried out; and they would be of enormous value in the near future. As soon as they got into the meshes of the calorific standard, as well as the illuminating value, it would become one of the prime factors in calculation. Some coals gave good illuminating value and very poor calorific value; and they wanted to know which were the coals they could rely upon for one as well as for the other.

PAPERS READ.

PHOTOMETRY AND TESTING.

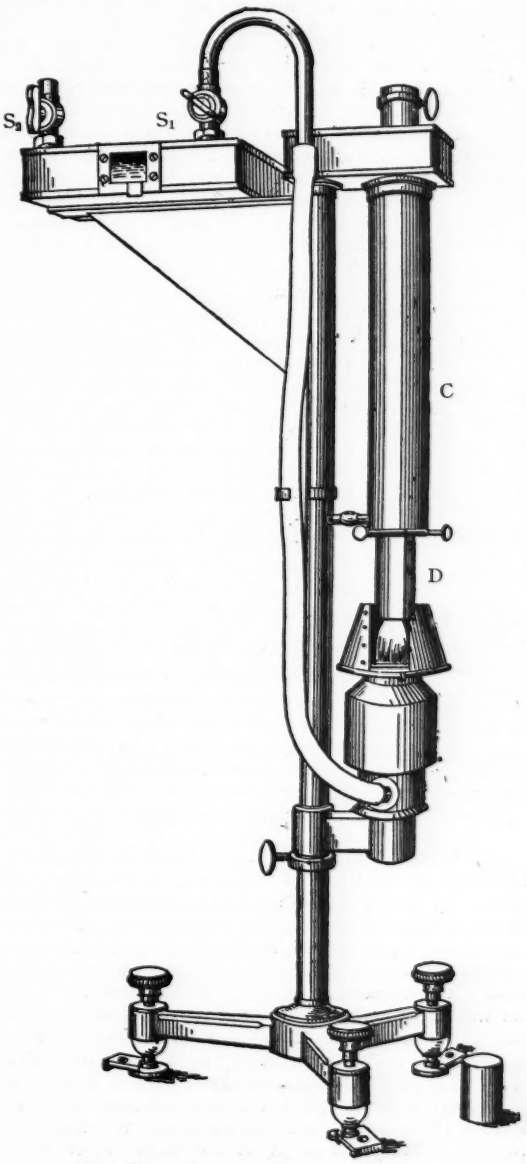
By Walter Grafton, of London.

During the last four years, great changes have taken place in the methods of photometry as applied to the testing of illuminating gas. By the introduction and adoption, in the winter of 1898-1899, of the table photometer and the Harcourt 10-candle pentane-air standard as the official apparatus, many of the disturbing factors have been removed in the practice of photometry. So great have been the benefits, if not the blessings, to the gas profession by the introduction of a varying rate at which the gas shall be consumed in the argand burner, that it may be thought this much-needed change would result in giving satisfaction to everyone concerned.

This, however, is by no means the case, as is evidenced by the Parliamentary Bills of recent time. It is, therefore, the purpose of this paper to touch upon the "weak spots" that remain in the present system of official testing, in the hope that they may be remedied, and also to show that some of the existing beliefs as regards burners generally are wrong. Time will not allow of great detail being given; but the author hopes it will prove a subject for useful discussion, and the furtherance of greater accuracy in our methods of testing. As the author supposes you all to be more or less familiar with the table photometer (since a general description of it was given at the meeting of the Gas Institute in 1901), it may suffice if only the "shortcomings" are dealt with.

The Ten-Candle Lamp.

This is an admirable standard; but careful use is necessary in order to get accurate results with it. In the Notifications of the Gas Referees from 1898 to the summer issue of 1900, the lamp is illustrated showing only the outlet tap of the carburettor partly open, in order to regulate the pentanized air; while the inlet tap S_1 is shown fully open. This is certainly the proper way to regulate the flow of vapour, and consequently the size of flame. A more thoroughly saturated mixture of air and pentane vapour for all temperatures is thus secured. In succeeding Notifications, the regulation may be either by the inlet or outlet tap, or both; and a further illustration of the method of controlling the inlet air is shown. This is to enable the operator to adjust the flame without leaving his seat.



The Ten-Candle Pentane Lamp.
(Reproduced from the Gas Referees' Notification.)

Now, since the inlet air is under control, the outlet tap might just as well be fully open, but for the fact that when the valve is raised too much, the flame smokes badly. This method, unlike the regulation of the outgoing vapour, means varying degrees of air saturation; for in hot weather, and in hot rooms, the inlet tap can be entirely shut—showing that absolute pentane vapour is being consumed. In the testing-rooms, between winter and summer, we have a variation of at least 40° Fahr. Consequently, in winter, when the room is cooled down, the flow of pentane must be increased so as to raise the flame to the regulation height; while in summer, with prevailing temperatures of 85° to

90°, the quantity of air used as a carrier or displacer is exceedingly small, thereby affecting the value of the standard. As proof of this, place the carburettor in a bath in such a way that water of known temperature may be caused to flow in and out. The following results have been obtained, after allowing time for pentane to assume the temperature of water.

Temperatures of			Ill Power of Gas.	Gain in Light due to Reduction of Standard Flame Value.
Room.	Meter.	Water passing Carburettor.		
Fahr.	Fahr.	Fahr.	Candles.	
64°	64°	52°	16·21	—
64°	64°	92°	16·76	0·55 candle.

All other conditions, it may be mentioned, were the same. The carburettor was two-thirds filled with pentane. These results show that pentane is vapourized to a much greater extent at the high temperature; and the extra pentane vapour is not so well consumed and the flame is less brilliant. The regulations may easily be departed from, since no mark is on the carburettor to indicate when two-thirds full. It is stated that "the height of the liquid as seen against the windows may not be less than one-eighth of an inch." It is not very clear what is really meant here, whether the pentane must not go below the line of two-thirds full by more than one-eighth of an inch, or may fall to an eighth of an inch from the bottom. This makes all the difference. The carburettor used by the author was so marked that it should be exactly two-thirds full and kept to within $\frac{1}{8}$ inch of this amount by additions of pentane about every two hours. As to the setting of the flame, the lamp chimney should have a definite mark on the window, or a cross-bar set to where the flame should be kept. It is very easy to keep a steady flame when adjusted by the outlet tap of the carburettor or inlet to the burner, but next to impossible when regulated by the inlet tap. In practice, using the lamp every half-hour, it has been found more reliable to gradually regulate the outlet tap by means of a weighted lever and cord. The lever is slotted, and slips on to the handle of the tap in such a way that should the cord or adjusting screw get moved by accident, the tap closes itself owing to the weight on the opposite end of the lever. Accordingly, tests by the two methods have been made alternately at temperatures representing winter and summer averages.

No. of Tests.	Temperature of Room.	Ill. Power by S_1 Regulation.	Ill. Power by S_2 Regulation.	In favour of S_2 Regulation. Candle.
203	58°	16·42	16·52	0·100
100	78°	16·72	16·815	0·095

These figures clearly show that the air is not so thoroughly saturated by checking the air by the inlet tap, besides the method is nothing like so pleasing to manipulate. The normal length of the flame should be (approximately) $2\frac{7}{8}$ inches; but when set to the cross-bar it is $3\frac{5}{16}$ inches, or to the bottom of the window $2\frac{7}{16}$ inches. It is stated that $\frac{1}{4}$ inch either way of $2\frac{7}{8}$ inches makes no material difference in the value of the standard. True, it is not much; but when making official tests it is necessary to be exact, and particularly so when a little more or less length of flame makes quite enough difference, either in causing or preventing the gas from being sometimes shown below the limit which governs a penalty. This is all the more enforced by the fact that if the gas happens to be below 16 or 14 candles, the second figure in decimals must be recorded, therefore showing the importance of so small a fraction of a candle. Allowing the standard an hour to burn, in order to get a constant temperature (so that the air which supplies the centre of flame may be constant), these results have been found—

	Flame set at Right Height.	Flame set to Cross-Bar.	Flame set to Bottom of Window.
Series I. Mean . .	16·31	16·57	16·04
,, II. Mean . .	16·05	16·32	15·85
Total average . .	16·18	16·44	15·94
			16·19

Since the total difference in the flame lengths between the cross-bar and the bottom of the window is $\frac{7}{8}$ inch, and that the flame can vary $\frac{1}{2}$ inch, one is entitled to take half the extreme difference found above (0·25 candle) as representing what does happen by casual variation in setting the flame to midway between the bottom of the window and the cross-bar. On page 3 of the Notification, it is stated that the lamp must burn for at least ten minutes before making any testing; yet on page 13 we read that, "after the lamp has been lighted for a quarter-of-an-hour, the tendency of the flame is to become lower, the saturator may be placed a little nearer the central column." Evidently the Gas Referees know that the lamp does vary, due to the degree of pentane vapour supplied to the flame not being constant, or they would not have made this stipulation.

Again the carburettor was immersed in a bath through which tap water was constantly running; a testing being made in the ordinary way (I.). Then the same gas (burning all the time) was again tested. After allowing the Harcourt lamp to burn on the verge of smoking at the top of chimney for five minutes, it was again adjusted to the proper height (II.)—

Series XV. (45 *Tests*).

		I.		II.	
Temp. of Room.	Temp. of Pentane.	Index Reading.	Ill. Power Candles.	Index Reading.	Ill. Power Candles.
63°	46°	18·45	16·29	17·56	16·69

This shows a gain of 0·4 candle by reducing the quantity of air fed to the centre of the burner. Owing to the tube C getting very hot, and with it the exterior tube D, the air passing up the interspace is rarefied, and therefore does not contain so large a volume of oxygen as is supplied by the tubes when at a lower temperature. Consequently the flame is not so bright. Hence the following conclusions to which the author has come in order to make the standard a practically accurate one throughout the year.

When the parts of the lamp have become thoroughly heated, and the vapour regulated by the outlet tap so that the flame is $2\frac{7}{8}$ inches in length, and the chimney tube C set, when cold, to 47 mm. above the steatite burner, the standard is worthy of being called by that name, and is as reliable as it is possible to get one.

The Aërorthometer.

This instrument is most unreliable, and when carefully adjusted does not remain accurate for longer than three days, not to speak of a month. It is much better to correct by the tabular number. A long comparison of the methods of correction for variations of the atmosphere gives—

16-Candle Gas Corrected by

Comparisons.	Tabular Number.	Aërorthometer.	Almost constant error liable to occur by using Aërorthometer.
117	16·20	16·09	0·11 candle.

Photoped Paper.

For sensitive reading, white paper is not to be recommended. There is a glossy appearance about it resembling water marks, no matter how fine the grain; it may be that it is too translucent. But the line of vision should be direct, and not by moving the head to view each side. The author has found a fine grained paper, slightly tinted yellow, to be far more sensitive to changes in illumination, and blending more certain, when the sliding-tube containing the slotted diaphragm is set so that the contiguous illuminated portions of the paper just meet, and are of equal illumination. There should not be any trace of a darker or lighter line down the middle of the paper. This setting is stated in the Notification, and is a necessary one, since it adds greatly to the accuracy of the observations.

Regulating Tap.

This is an important part of the apparatus, and one that needs bringing up to date. It is a very old way of making a tap, and, in practice, does not work well. The saw-cuts, being so fine, soon get choked with water; and to clear the same the plug must be removed. It is better to remove the washer and clamping screw than to have the plug locked in. The plug is then easily taken out, cleaned, and replaced in a few seconds without the necessity of having to disconnect the pipes from it. Being nicely ground in, there is no fear of leakage. A round hole on each side of a hollow plug, of any size except such

as will pass 4 cubic feet when fully open at about 20°, and any further quantity of gas up to about 6 feet in all, must pass through the saw-cuts, as indicated by the pointer travelling over a further 60° or 70° on the arc, means anything or nothing since the quantity of gas is governed by the amount of pressure that may be used at the outlet of the governor, or rather the initial pressure at the inlet of the meter. A pressure gauge, of U shape at least, should be fitted on the inlet of the meter to indicate the pressure in tenths of an inch; and from the many experiments made with varying pressures, an operator unknowingly varies his results. Without the use of a gauge, he is therefore ignorant of the amount of pressure he may have on; and it is essential to work with a definite figure.

The inlet pressure should be 15-10ths; and this could always be noted quickly by having a mark on the glass, as a piece of gummed paper, to which the liquid must rise and fall. The pressure at the outlet of the governor might easily be 3½ inches—it all depends upon the adjustment of the balance-governor. With the Letheby apparatus, 12-10ths to 13-10ths used to be the amount registered by the King's gauge at the inlet of meter; but with the table photometer, this factor has been overlooked. Then, again, the pressure affects the index readings, and it is found to be most accurate, and greater reliance can be placed upon results that are made with an inlet pressure of 15-10ths and the index readings falling between 12° and 16° on the arc. When so placed, the operator will find the index the same almost every time; and he must read to a quarter of a degree, and set his mean reading carefully. It would be advantageous to have a longer index arm, and so get a wider range between each degree. There is not the same dependence to be placed on the results obtained from readings above 20°, unless certain precautions are taken. As proof of this, repeat the tests with gas from a 5 or 10 feet holder, with the governor adjusted to get a reading of (say) 30°. Between each reading differences of 1, 2, or more degrees will be found; and each degree represents a second or two, equal to one or two tenths of a candle.

The following table shows a few out of fifteen series of tests carried out under different conditions and pressures at the inlet of meter. The standard being always manipulated in the same way. A regulating plug was used, having one long wide saw-cut and no circular hole on each side. This has the advantage that every movement of the plug allows more or less gas to pass in regular proportion, and the orifices do not become so readily choked with water. Series C. and D. show that either plug is equally affected by the method of setting and adjusting pressure to readings.

Series.	No. of Tests.	Pressure. Inches.	Pressure set with tap a degree.	Mean Index Reading.	Illuminating Power. Candles.	Pressure. Inches.	Pressure set with tap at degree.	Mean Index Reading.	Illuminating Power. Candles.	Difference in Ill. Power in favour of lower index reading.
IV.	92	1·2	19·00	18·00	16·48	3	11·25	11·25	16·73	0·25
VI.	47	1·2	18·00	19·00	16·38	3·6	11·00	11·00	16·71	0·33
VIII.	70	1·2	18·00	19·74	16·55	1·2	18·00	19·70	16·558	0·00
X.	50	3·0	18·00	19·30	16·61	3·0	18·00	19·28	16·62	0·01
XI.	50	3·0	11·25	12·24	16·63	3·0	11·25	11·23	16·64	0·01
B.	51	1·5	15·50	15·54	16·30	1·5	additional W. on C.B.	53·5	16·25	0·05
C.	153	1·5	11·00	11·25	16·41	1·5	11·00	22·33	16·18	0·23
D.	48	1·5	Offici'l 11·25	Plug 11·25	16·12	1·5	11·25	24·30	15·91	0·21

W. on C.B. = Weight on Counterbalance of Governor.

The table of tabular numbers given in the Notification does not always include the conditions that are sometimes met with in summer; and it provides further that the gas examiner shall determine the illuminating power by means of the formulæ given below the tables. This he cannot do, because the tension of aqueous vapour for temperatures above 84° is not given.

The Argand Burner.

This is an admirable burner so long as it is supplied with 16 to 17 candle coal gas, and gives practically the full duty of 3·3 candles per cubic foot when burned at the rate of 5 feet per hour. Times have changed greatly since the passing of the City of London Gas Act in 1868. Coal gas was then recognized as the only article manufactured in gas-works, with or without the addition of a small percentage of enrichment. The enrichers used at that time did not affect the duty obtainable from the argand; but with the introduction of oil carburetted water gas the mixtures of 16 candles and under this value, as determined by this burner, either by a 5-feet rate or a 16 candle flame-basis are undervalued, and the consumers and manufacturers are deceived by the results at present obtained. The burner is just suited for consuming, at the 5 cubic feet per hour rate, such carburetted gas of 20 to 23 candle value (corrected for temperature and barometric pressure), but no more. By the 1868 Act, the Referees prescribe the burner for testing; and it must be one that will develop "the greatest amount of light" from the gas, at the same time adapted for use by the consumer in the same sense that argands generally are.

New Acts, since the notable South Metropolitan Gas Company's Act of 1900, all provide for a lowering of the illuminating power to 14 and 13 candles; and as no burner of equally satisfactory construction as the "London" argand was known at the time, it was adopted, but with this precautionary measure—that the gas should be consumed to give a 16-candle flame in a 6 in. by 1¾ in. external diameter chimney, and calculated back to 5 cubic feet. The candle power thus obtained per 5 cubic feet of 14-candle gas is not the same as if the gas had been tested at that rate in the burner, but what it would have been if, at that rate, it had yielded the same light per foot as when tested with a 16-candle flame. Had the candle value been arrived at close upon the 5 cubic feet rate, a much lower value would be obtained by the use of this burner. But that is not to say that the 16-candle flame method is doing full justice to the gas. The gain in value so arrived at between the two methods should not exist, and in reality does not exist when the gas is consumed properly in a proper burner that develops all that is in the gas. The burner may be one that does or does not consume the gas efficiently; hence, what is not in the gas cannot be got out of it. This is made clear by tests of mixed gases, which show the following results: 14-candle rate, 15·20 candles; 16-candle rate, 16·23 candles; 18-candle rate, 16·60 candles; 19-candle rate, 16·63 candles. This clearly shows that the official burner is not suited to develop the maximum light at 16 candles, but that more gas must be consumed, equivalent to getting an 18-candle flame. Gas companies should be allowed the full duty that is in their gas, and they in turn instruct the consumers how best to burn it with economy and not with waste. It is only by studying the interests of consumers that gas companies can expect to get increased business.

The method prescribed for testing the Commercial Company's gas did a distinct injustice to the gas, and gave to the consumers nearly 1½ candles more than they paid for or were entitled to get. The conditions under which gas should be consumed in order to develop the full illuminating power are not even yet properly understood; and the author hopes, by the reading of this paper, to remove one of the injustices pervading the gas industry. If he succeeds in showing a better and more accurate method of testing lower candle power gas in a way that justice is done to it, at the same time preserving a uniformity of method—*i.e.*, developing practically the maximum value of the gas—some advancement will have been made in the art of photometry, and a better and more equable balance obtained by which to measure our commodity.

The 5 cubic feet rate is one that must be adhered to in the sense that all calculations and comparisons are based upon it, and recorded in terms of the light given by the consumption of this volume of gas per hour. The adoption of the present method of flame-values instead of fixed rates of consumption of gas is the cause of satisfaction and dissatisfaction among many gas experts; and expression has been given to the effect that the table photometer, as one instrument, gives an undue advantage to the gas of something like 8 per cent. in the lighting value as compared with former methods. This is absolutely wrong and extremely misleading. The only way to remove such doubts is to consume gas approximately to 5 feet per hour, but at such a rate as shall yield a flame-value of the candle power of the gas sanctioned by Parliament for supply by any particular

company or corporation in a burner, and in a way, that rightly develops the highest light from such volume of gas. The volume of light in the argand should be about the same for all gas of and under 16 candles. It is necessary towards securing accuracy in photometry that the light from lower quality gas should be of nearly equal unit area of luminous combustion to the 16-candle flame; so that the photoped is equally affected.

In testing (say) 14-candle gas, the burner should be one that secures these conditions, and produces 14 candles at about 5 cubic feet—similar to the 16-candle gas; but the gas should be tested with a 14-candle flame in a suitable chimney in order to get economic luminous combustion. The provisions stated in Appendix D of the Notification are to some extent antiquated and irregular. There we find one gas having a standard quality of 16 candles to be tested in the "London" argand with a 6 inch by $1\frac{7}{8}$ inch internal diameter chimney; while two other companies' gas (each of a different kind, yet both of standard 14-candle value) is prescribed for differently—one to be tested with a 16-candle flame in a 6 inch by $1\frac{5}{8}$ inch internal diameter chimney, the other with the same chimney but only sufficient gas consumed in the argand as will produce a 14-candle flame.

To say the least, these methods give divergent and incorrect results. Besides, a greater injustice is done to one gas more than the other. As a matter of fact, the diameter of these chimneys has practically no bearing in the case, because the quantity of air passing through them is almost identical. The outlet of the smaller chimney is much larger than the area of the combined inlets to it; and while the inlets are the same for 16 as for 14 candle gas, the quantity of products and air passing out at the top is only slightly affected by the volume of gas consumed. Therefore, the larger chimney only passes the products away at a slower speed, because it has a freer outlet. A change of chimney of equal temperatures means an increase in the length of the flame of $\frac{3}{16}$ inch to $\frac{1}{4}$ inch when the 6 inch by $1\frac{5}{8}$ inch chimney is substituted for one of 6 inch by $1\frac{7}{8}$ inch; because the smaller glass cramps the current of air, and so the flame is carried up in conformity with the length of the flame.

Now about the year 1876, it was, and to some extent still is, thought that if the then so-called 14-candle gas mounted above the top of a 6 inch by $1\frac{5}{8}$ inch chimney, it would not do so in a 6 inch by $1\frac{7}{8}$ inch one. Perhaps not; but a deduction must first be allowed of about $\frac{1}{2}$ inch in the length of the flame. This is due to the aforesaid reason. Remember also that in those days the gas was consumed during a testing at a fixed rate of 5 cubic feet per hour; and that is why this clause was put in the Notification of the Gas Referees. To-day this is not necessary, as it is impossible for the gas to smoke in the smaller chimney prescribed, because the 14-candle flame-value governs, in a way, the consumption; and therefore a 16-candle flame-value is produced long before the point of smoking is reached. This 16-candle method does not help the poorer gas much when it happens to be perilously near the point of penalization; and particularly is this the case with the gas supplied in the area North of the Thames.

SECTION OF GRAFTON'S BURNER.
(For Lettered Description and Dimensions, see "JOURNAL" for Feb. 17.)

It is because of these irregular methods that greater uniformity and accuracy in testing gas are desirable, so that a more accurate knowledge (without prejudice) of the cost can be obtained for comparison with gas supplied to the public by other companies, and also, particularly, for evidence useful in Parliamentary Committee Rooms. Consequently, the author, after much thought and experiment, has devised a modification of the "London" argand that fulfils the aforesaid conditions and the requirements of modern gas making and supply. A description of this burner will be found in the "JOURNAL OF GAS LIGHTING" for Feb. 17 last. Suffice it to say that the different qualities should be expressed similar to the following:—

5 ft. of 16-candle-gas = 16 candles			or 3·2 c. per ft.
5 ft. of 15 ,, gas = 15 ,,	(not 5·33 ft. = 16 candles)		or 3·0 ,,
5 ft. of 14 ,, gas = 14 ,,	(not 5·71 ft. = 16 ,,)		or 2·8 ,,
5 ft. of 13 ,, gas = 13 ,,	(not 6·15 ft. = 16 ,,)		or 2·6 ,,

The efficiency of 2·8 candles for 14-candle gas by the 16-candle flame method is too low for the quantity of gas consumed. As a matter of fact, the gas is actually 1-10th to $1\frac{1}{2}$-10ths of a candle in efficiency better. Note the comparative tests (opposite page) for any particular:—

AIR SUPPLY.

The quantity of air supplied to the "London" argand burner is always in excess of that supposed to be sufficient to ensure combustion when the gas is below $16\frac{1}{2}$-candle coal gas. The following determinations have been made:—

14-Candle Gas.

Official Burner.	Improved Burner.	
6 in. chimney and 16-candle flame.	5 in. chimney and 14-candle flame.	Gain in candles over official 16-candle flame method.
Cubic feet of air to 1 of gas.	Cubic feet of air to 1 of gas.	
Coal gas = 7·4 or 7·2 per cent. more air than should be.	6·90	0·37

16-Candle Gas.

16-candle flame.	16-candle flame.	
Mixed gas = 8·41 or 12¼ per cent. too much air	7·5	0·61

In Official Burner with 14·20-Candle Coal Gas using a

6 in. by 2 in. chimney and 16-candle flame.	6 in. by $1\frac{3}{4}$ in. and 14-candle flame.	6 in by 2 in. chimney full of flame or 4¼ in. flame.
Ratio of air to gas. 7·96	8·09 = gas 0·8 candle worse.	6·57 = gas, 0·3 candle better.
0 per cent.	1·63 per cent. more air.	17·46 per cent. less air.

According to theory, if the air be taken for 16-candle coal gas as 100, then 14 and 13 candle gas respectively should require 14-16th and 13-16th of this amount, which would be 87·5 and 81·2 per cent. of the whole, or 12·5 per cent. and 18·8 per cent. less air for complete economic combustion. But since 14 and 13 candle gas, of whatever kind, has for a time to be tested in the "London" argand at such a rate as will yield a light equal to 16 candles, you will not get just that quantity of air as is represented by 100, but something like 5 to 9 per cent. more, according to the nature or composition of such gas. Even 16-candle gas, which may be a mixture of coal gas and carburetted water gas, will be supplied in the "London" argand with an excess of air. Mere candle-value is no indication of the quantity of air that must necessarily be supplied to bring about perfect luminous combustion.

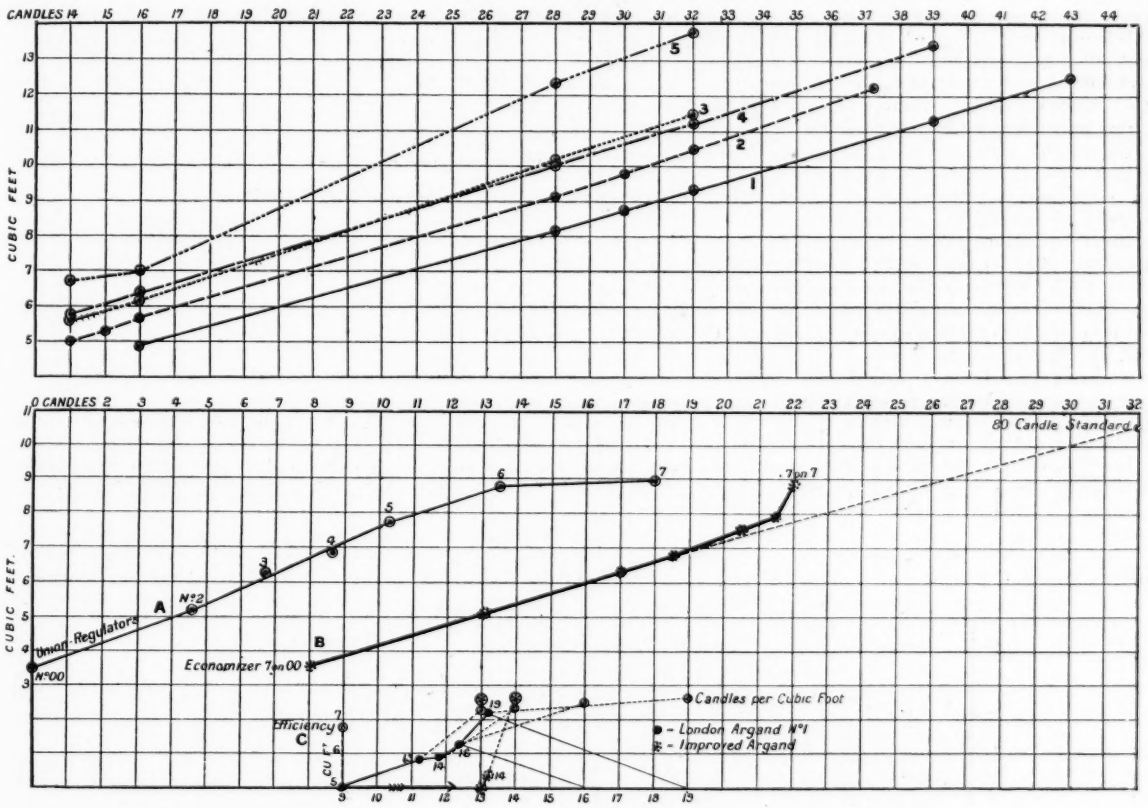
It is for this reason that those companies and corporations who supply a mixture of coal gas and carburetted water gas should be differently treated as regards testing to those who supply the neat coal gas, although all companies should have an extra quarter-of-a-candle's grace in case of penalization. To penalize a company because its gas is half-a-candle below the standard fixed by statute, when the method of determining the illuminating value is prejudicial to the extent of an equal amount, is grossly unfair; and the controlling authorities, by so enforcing the penalty, are indirectly throwing burdens upon gas consumers as a body, instead of looking after their interests. The consumer desires no more than the quality he pays for; and he is always better pleased when he knows that the price of the gas is to be 1d. or so less per 1000 cubic feet.

With reference to curve C on the diagram, of which other detailed figures are given in the comparison table C, it requires but little explanation. The continuous line represents the results corrected to 5 cubic feet, but plotted on the points of actual consumption; whereas they depart greatly from the flame-value line at which they should come close upon if the light per cubic foot had been uniform, and each flame required just 5 feet. A very different curve is shown by the tests made with the improved burner, using a 13 and 14 candle flame. In the table, the efficiency at 5 cubic feet is only 1·81 candles; whereas, by consuming more gas, the 16-candle flame efficiency is then only 2·47. Using a flame of 19 candles gives the maximum, or $6\frac{1}{2}$ per cent. more light—clearly showing that the 16-candle flame method is not doing full justice to 13-candle gas, which can be so developed in the improved burner, with about 5 feet and producing the maximum effect per foot, without departing

Gas of Similar Composition to that Supplied by (say) The Gaslight and Coke Company.

London Argand.						Grafton Argand.				Wandsworth Argand.		
6 in. × 1⅞ in. Chimney, 16c. basis, Ill. Power.	Gas Consumed, Cubic Feet.	6 in. × 1⅝ in. Chimney, 16c. basis. Ill. Power.	Gas Consumed, Cubic Feet.	6 in. × 1⅝ in. Chimney, 14c. basis, Ill. Power.	Gas Consumed, Cubic Feet.	5½ in. × 1¾ in, Chimney, 16c. basis, Ill. Power.	Gas Consumed, Cubic Feet.	5 in. × 1¾ in. Chimney, 14c. basis, Ill. Power.	Gas Consumed, Cubic Feet.	7 in. × 1⅝ in. Chimney, 14c. basis, Ill. Power.	Gas Consumed, Cubic Feet.	Percentage the Official Method Undervalues the Gas.
16·29	4·90	16·20	4·95	—	—	17·0	4·66	—	—	—	—	4 36
or the South Metropolitan Company:												
14·10	5·67	14·14	5·66	13·28	5·27	—	—	14·58	4·80	—	—	3·40
or the Commercial or West Ham Company:												
								4½ in. × 1⅝ in. Chimney.				
15·00	5·33	15·00	5·34	14·10	4·96	—	—	15·55	4·45	15·57	4·45	3·4 11·0
Commercial Company's gas by Gas Referees' Method or the Crystal Palace Company:												
—	—	13·24	6·10	12 40	5·70	—	—	14·07	5·03	—	—	6·27

For further proof of the inefficiency of the London Argand see Tables 1 and 4.



from a 13-candle flame, and thereby securing the true value of the gas. This is not a mere gain of 8 per cent., but a loss of 26 per cent. on the 16-candle basis; whereas the true value, at 5 cubic feet, is an honest gain of 43 per cent.—an amount not to be lightly put on one side. This is also borne out by the "Wandsworth" burner.

With such gas in flat-flame burners, quite another tale is told. The highest obtainable efficiency from 13-candle gas by flat flames is 2·2 candles; and this is only to be got at the expense of 137 per cent. more gas than is consumed by the argand. With the economizer type of burner, an efficiency of 1·89 to 1·87 candles is obtainable from a consumption of 5 cubic feet—increasing uniformly upwards. Even this is not to be ignored, and is very satisfactory considering the small quantity consumed and the method of burning such a quantity of gas. Governor burners, as a class, however, are inferior to the economizer type of flat-flame burner by 15 to 30 per cent., besides costing much more. Taking gas generally of less than 15½ candles value, the former burners cannot possibly do better than the "London" argand at 5 cubic feet. They retard the flow of gas, but do not develop the most light from that consumed. As an instance, 9 candles is the value of 13-candle gas by the "London" argand. Consequently, one cannot expect a much higher result, if any, from even the best of flat-flame burners. Incandescent burners must then come to the rescue; and when fitted with governors they give greater satisfaction.

Curves A and B are very instructive; B indicating a steady increase in light in proportion to the consumption when rightly blended to suit the pressure. Here we have a perfect system of governing the consumption, together with efficiency; and such burners should be widely used by those consumers who rely upon, and like, flat-flame lighting. Such economizers would be even better if they had a larger top, which is necessary for this lower quality of gas. See details in Tables A and B.

Curves 1, 2, 3, and 4, and the detailed figures relating to each, are particularly instructive, as they show that for flat-flame burners to give an equal number of candles per foot of gas consumed to that obtainable with the "London" argand, gas of below 16 candles must be consumed at double the rate and about double the ignition pressure; but below 14½-candle coal gas it is not possible to get the maximum value from any quantity of gas consumed by flat-flame burners. Tables III. and V. strengthen this inference.

Table IV. gives figures relating to a mixture of coal gas and carburetted water gas of so-called 14 candles; but the actual value is about ¾ candle more as tested in the improved argand. With this kind of gas, it is possible to develop the maximum light with flat-flame burners; and therefore 14-candle mixtures are easier developed than 14-candle coal gas with such burners. Heating values of this mixture, and of the gases of which it was made, are also given. When 14-candle coal gas is properly tested, the candle units are only a little more than is found for 16-candle coal gas. In Table VI. will be found a few useful figures which are self-explanatory.

TABLE A AND B.—*So-called* 15½-*Candle Coal Gas.*

Kind of Burner.	Size of Chimney and Flame.	Illuminating Power, Corrected.	Length of Flame.	Consumption of Gas.	Candles Per Foot.
	Inches.	Candles.	Inches.	Cub. Ft.	
"London" argand.	6 × 2 × 16	15·57	2¾	5·3	3·01*
	6 × 1¾ × 14	14·88	2½	4·85	2·88
Do., with Grafton improvement.	6 × 2 × 16	16·11	3⅛	5·125	3·12*
	5 × 2 × 14	16·04	2⅝	4·5	3·11*

	"A" Curve on Diagram.				"B" Curve on Diagram.			
	Pressure. Tenths.	Light Emitted.	Consumption of Gas.	Candles per Foot.	Size of Economizer Used on Top.	Light Emitted.	Consumption of Gas.	Candles Per Foot.
No. 00 union regulator	15	No light	3·50	..	No. 7	7·95	3·55	2·20
No. 2 ,, ,,	,,	4·6	5·15	0·90	,,	13·00	5·05	2·57
No. 3 ,, ,,	,,	6·8	6·20	1·09	,,	17·00	6·30	2·70*
No. 4 ,, ,,	,,	8·7	6·90	1·26	,,	18·60	6·80	2·73*
No. 5 ,, ,,	,,	10·4	7·70	1·35	,,	20·40	7·45	2·73*
No. 6 ,, ,,	,,	13 5	8·75	1·54	,,	21·50	7·90	2·73*
No. 7 ,, ,,	,,	18·0	8·95	2·01*	,,	22·00	8·90	2·47†
No. 80 special	10	32·1	10·60	3·02*				
No. 8 batswing	,,	14·5	7·10	2·04*				

* Compare these results. † Bottom burner too large.

TABLE C.—13-*Candle Coal Gas as Manufactured.*

"C" Curve on Diagram.

Name of Burner.	Size of Chimney and Flame Value.	Illuminating Power Corrected.	Length of Flame.	Consumption of Gas.	Candles per Foot.	Pressure under Burner.	Remarks.
	Inches.	Candles.	Inches.	Cubic Feet.		Inches.	
Official "London" argand.	6 × 1⅝ × —	9·05	1⅞	5·00	1·81	..	Old method.
	6 × 1⅝ × 16	12·37	3⅛	6·50	2·47*	..	Official method.
	6 × 1⅝ × 19	13·19	4⅜	7·20	*2·63*	..	Actual or maximum value, 6·54 per cent. gain.
	6 × 1⅝ × 14	11·83	2¾	5·95	2·36	..	
	6 × 1⅝ × 13	11·26	2⅝	5·80	2·25	..	
Improved "London" argand.	5 × 1⅞ × 14	13·18	2⅞	5·35	*2·63*	..	Actual or maximum value, 6·54 per cent. gain.
	4½ × 1⅞ × 13	12·98	3	5·05	*2·60**	..	
"Wandsworth" argand.	7 × 1⅝ × 14	13·17	5¼	5·35	*2·63*	..	Actual or maximum value (but the long flame is against this burner), 6·54 per cent. gain.
	7 × 1⅝ × 13	12·96	4½	5·06	2·59*	..	
	6 × 1⅝ × 14	useless, flame above chimney				..	
	6 × 1⅝ × 13	,, ,, ,,				..	
		Light emitted.					
5-feet governor burners. A	..	8·8	..	5·50	1·41	1	Maximum value obtainable from governor burners, or 1 candle in efficiency less than actual value.
,,	..	9·5	..	5·75	1·65	1½	
,,	..	9·5	..	5·85	1·62	3	
A¹	..	7·4	..	5·45	1·35	1	
,,	..	8·0	..	6·00	1·33	1½	
,,	..	8·4	..	6·10	1·38	3	
B	..	7·4	..	5·25	1·41	1	
,,	..	7·2	..	5·75	1·25	1½	
,,	..	8·2	..	6·35	1·29	3	
C	..	7·2	..	5·40	1·33	1	
,,	..	7·6	..	5·70	1·33	1½	
,,	..	7·8	..	5·95	1·30	3	
Flat-flame ungoverned burner. D	..	13·0	..	6·70	1·94	½	
,,	..	26·0	..	11·85	2·19	9/10	
E	..	9·95	..	5·30	1·88	1½	

* 13-candle flame values better than 16-candle one.

Tables and Figures Relating to Curves Nos. 1, 2, 3, *and* 5 *on Diagram.*

Kind of Burner.	Burner Pressure in Tenths.	Light Emitted.	Consumption of Gas.	Efficiency per Foot.	London Argand.			Kind of Gas.
					Ill. Power 16 c. Basis.	Consumption of Gas.	Efficiency.	
		Candles.	Cub. Ft.	Candles.	Candles.	Cub. Ft.	Candles.	
No. 50 Special Flat-flame	4·00	16	4·95	3·23*	16·08†	5·00	3·21*	Mixture of coal gas and one-third carburetted water gas
	7·00	28	8·15	3·43*	..	..	..	
	8·00	30	8·80	3·40*	..	..	..	
(No. 1 on Diagram.)	8·50	32	9·30	3·40*	..	..	..	
	11·00	39	11·40	3·41*	..	..	..	
	13·50	43	12·55	3·42*	..	..	..	
No. 50 Special Flat-flame	3·50	14	5·00	2·80	15·15	5·30	3·02*	Coal gas
	4·00	15	5·35	2·80	..	..	..	
	4·25	16	5·60	2·85	..	..	..	
	7·00	28	9·20	3·08*	..	..	..	
(No. 2 on Diagram.)	8·00	30	9·80	3·06*	..	..	..	
	9·00	32	10·50	3 02*	..	..	..	
No. 50 Special Flat-flame	3·50	14	5·65	2·65	14·19	5·65	2·83*	Coal gas
	5·00	16	6·15	2·60	..	..	..	
	8·50	28	10·10	2·77	..	..	..	
(No. 3 on Diagram.)	10·00	32	11·50	2·78*	..	..	..	
No. 50 Special Flat-flame	5·00	14	6·75	2·07	12·90	6·20	2·58	Poor coal gas
	5·50	16	7·00	2·28		14-candle flame		
	10·50	28	12·40	2·25	12·06	5·80	2·41	
(No. 5 on Diagram.)	12·50	32	13·80	2·32	..	..	..	

Certainly not the true value (see and compare for each gas *).

TABLE IV.

Data and Figures Relating to Curve No. 4 on Diagram.

Kind of Burner.	Pressure at Burner in Tenths.	Light Emitted.	Consumption of Gas.	Efficiency per Foot.	Kind of Gas.
		Candles.	Cub. Ft.	Candles.	
No 80 Special Flat-flame . .	4·25	14·00	5·75	2·43	14-candle mixture, two-thirds coal gas and one-third carburetted water gas.
	4·75	16·00	6·30	2·54	
	8·50	28·00	10·00	2·80	
	10·50	32·00	11·30	2·83	
	14·50	39·00	13·40	2·91*	

—	Size of Chimney and Flame.	Ill. Power.	Calculated Ill. Power from Coal and C. W. G.	Efficiency per Foot.	—	True Heating Value in British Thermal Units.		
	Inches.	Candles.	Candles.	Candles.		Gross.	Net.	Per Candle Gross.
"London" argand	6 × 1¾ × 16	14·02	..	2·80	Coal gas . .	584·0	527	40·51
Improved ,, ...	5 × 2 × 14	14·36	..	2·87				
"London" ,, ...	6 × 1¾ × 16	14·11	..	2·82	Carb. W. G. .	532·5	492	34·86
Improved ,, ...	4 × 2 × 14	15·30	..	3·06				
"London" ,, ...	6 × 1¾ × 16	14·10	14·05	2·82†	Mixture as above . .	566·0	513 calculated	38·47
Improved ,, ...	4½ × 2 × 14	14·71	14·67	2·94*		566·8	509	38·63

* Practically the same and more than shown at †

Specific Gravity in Relation to the Illuminating Power of Coal Gas.

"London" Argand, 16-Candle Flame.	Sp. Gr.	"London" Argand, 16-Candle Flame.	Sp. Gr.
17·17	0·449	15·25	0·392
16·71	0·424	14·90	0·388
16·47	0·411	14·25	0·384
16·29	0·404	14·06	0·380
16·01	0·402	13·75	0·378
15·84	0·394	13·50	0·377
15·74	0·394		

Discussion.

Mr. W. H. Y. WEBBER said he had followed Mr. Grafton's paper with all the attention he could, and there were one or two things which he thought might be considered with advantage. The paper really, although not in explicit terms, raised the great question of how the nominal illuminating power of varying qualities and makes of luminous gas should be determined; but he was not sure that it carried them very far towards answering the questions it raised. There had been a very great difference made of late years in the method of using the standard argand burner. This was strongly recommended in the first place by Mr. Charles Hunt, among others; and, certainly, using the "London" argand burner at a 16-candle flame rate had gone a long way towards making this particular burner applicable to determining the illuminating power of various qualities of gas. But he (the speaker) did not think Mr. Grafton had mentioned exactly why the burner was used for this purpose. It was because it was the only standard burner known either to the law or to technical practice—the only one sealed and stamped, and deposited at the Standards Department of the Board of Trade. Therefore it was a starting-point; and the attempts which had been made to use it for different qualities of gas were really referable to that legal consideration. The moment one went away from the standard burner of known dimensions, size, illumination, and so on, one got into vagueness; and there was really no firm ground whatever. When the standard burner was departed from, the question was at once raised as to what was the best burner for testing various qualities of gas. In the course of his paper, Mr. Grafton said: "The gain in value"—that was by the 16-candle flame method—"should not exist, and in reality does not exist when the gas is consumed properly in a proper burner that develops all that is in the gas." This begged the whole question. What was the proper burner? He did not find afterwards any indication that they had arrived at absolute perfection of a burner for developing all that there was in different kinds of gas. The author gave a table in which he took the "London" argand and applied to it a device for restricting the air supply to the middle of it. He did so, he believed, by putting a ring round it. Many "London" argands, apart from the standard burner, effected the same purpose by having a peg in the middle. What the difference in the performance might be between a round hole and a ring for admitting the requisite amount of air to the gas, he did not know; that remained to be shown. They were simply two ways of doing the same thing. From the table referred to, it appeared that what was called the Wandsworth argand absolutely gave a better result in one instance from the gas employed than the Grafton burner. This did not tend to show that finality had been arrived at; but it was still questionable which was the best way of regulating the air to the flame. Mr. Grafton dealt with this question, and said: "According to theory, if the air be taken for 16-candle coal gas as 100, then 14 and 13 candle gas respectively should require 14-16th and 13-16th of this amount." He did not know whose theory this was, because, if they were to take an extreme instance, according to that, if they had a non-luminous gas they would not want any air at all. The way in which the aëration of a luminous flame in the argand burner was conducted was totally different from the way in which the aëration of a bunsen burner was conducted. One could understand, if they were going to mix air with gas before ignition, that they might, if they had a constant quality of gas, arrive at some rule-of-three sum of this kind; but the aëration of a luminous flame was a different business altogether. The quantity of air which had to be brought to the flame, in order to complete combustion within a certain length of flame, depended very largely upon what was in the gas in the first place. If the gas owed its luminosity to benzene, for instance, it would take an enormous amount of air to prevent the flame tailing over the top of an ordinary 6-inch chimney. On the other hand, if it were a mixture of carburetted water gas, it would burn with a short flame. He was afraid he did not understand the point of there being any theory in the matter here. The same question arose on the tables at the end of the paper with regard to the so-called 15·2 or the so-called 13 candle gas—different qualities of coal gas. These qualities each required a special pattern of argand burner to develop the full amount of light which they were capable of yielding in this way; and not only did the construction of the lamp and the disposition of the chimney and the air supply vary with the rated quality of gas, but they also varied very largely with its composition. As they had just heard from Professor Lewes, it depended very much upon whether the illuminating power of the gas was due to the presence of a high proportion of ethane or benzene. This threw the whole matter open. In connection with this, he could not help referring to a very wise observation made by Mr. Charles Hunt in his book on "Gas Lighting" (Groves and Thorp's Series), where he drew attention to the great uncertainty existing in many returns of enrichment processes, and things of that kind, in which the results were stated to the effect that gas, to begin with, was 11½ candles, and by the addition of something, or by treatment in a particular way, the illuminating power became 16 candles. This looked like a positive definite statement; but it would be difficult to compress into so few words so many openings for misunderstanding as there were there. One did not know, in the first place, what was meant by the 11½ candles to start with. Did the gas

burn at the 5 cubic feet rate? Did the words mean burning with a 16-candle flame, with a chimney full of flame, or what did they mean, and what sort of burner was used to get it? Then when enrichment was put in, did one use absolutely the same argand burner, the same air supply, the same pressure, the same everything, to show 16 candles? because, if so, the duty would be different. They had heard a good deal about the need for standardization; but they had suffered already, in this matter of illuminating power, from over-standardization and from imperfect standardization. A very great point Sir John Brunner made in the Committee on the Crystal Palace Bill was that Parliament at last was waking up to the knowledge that it was a fatal thing to give statutory force to this, that, or the other particular instrument. The idea now was that people wanted to get a thing which would answer best, and they must modify the instrument as they required it, and not be bound hand and foot to anyone in particular. This was one thing to bear in mind; and the second was that the use of the "London" argand burner, as they knew it, had simply been forced on the gas industry because it was the only definite standard burner known. It was not at the present time the burner which corresponded to the spirit of the City of London Gas Act of 1868, which said the test-burner should be a burner best fitted to develop the illuminating power of the gas. The spirit of the clause had been re-enacted in the West Ham and other Gas Acts. This was the burner they wanted; but it was just the one which at the present time they had not got, or, if they had it, it was not recognized. He did not say that Mr. Grafton might not have done something towards attaining it; but, in the event of any organized technical work being undertaken by the Institution in the future, he thought that this was one of the points to which they might very profitably direct their attention.

Mr. H. E. Jones (London) said he noticed in the paper an allusion to the Commercial Gas Company's Act; and hearing from the last speaker a reference to the Wandsworth burner, and having recalled to his memory that morning, by Professor Lewes's lecture, some experiments he had made a year ago, it occurred to him that he might intervene in the discussion without wasting time. He thought it would be agreed that there was an inherent right in every manufacturer who was liable to a penalty upon the testing or sampling of his product, that he should at least have the full value of it developed. This spirit was shown in the clause of the 1868 legislation (which he was sorry to say they had by some oversight neglected to maintain in more recent Acts of Parliament), that the burner should be such as to give to the gas burnt the most favourable result. If they were to be hauled into a Police Court, they were at least entitled to have the fullest justice done to what they produced. He believed himself, from some experiments he had made in the course of the late parliamentary inquiry, that if one wanted a burner for general common use—and it was extremely convenient to have one—the No. 1 "London" argand, as crystallized in the South Metropolitan Gas Act, and used always to burn with a 16-candle flame, was fairly useful. But they could go one better than that; and Mr. Hunt had done so. This same burner acted better still with a great variety of gases, if it were used so as not to fill the chimney with flame. When there was no smoking in the chimney, but the maximum illuminating flame, the burner was acting at its best, no matter what was the illuminating power of the gas. In spite of Mr. Webber's somewhat caustic criticism as to the percentage of air required, which he agreed with him the author had stated a little too generally, as Professor Lewes had pointed out in his lecture, it was the air supplied to the burner that was the governing factor in the matter. When they were preparing their evidence for the Commercial Gas Company's Bill (which was not pressed because a settlement was arrived at), they had under review Mr. Grafton's proposed burner, and also another which he himself had suggested in conjunction with Sir Frederick Bramwell, and which they got Mr. Sugg to make, where the centre aperture was diminished by a cone rising by a screw base. They had also the Wandsworth burner, and another with Mr. Grafton's device with a ferrule in the central opening, instead of a device of the kind Mr. Sugg constructed under the instructions of himself and Sir Frederick Bramwell. The Wandsworth burner, which was really the Brentford burner, was nothing in the world but going back to the old 15-hole argand with a 7-inch chimney, which Dr. Letheby used to prescribe, when he improved an old brass burner by putting a steatite top into it, with Mr. Sugg's assistance. The Wandsworth, or Brentford, burner was simply one they had introduced at the Wandsworth Gas-Works. When they obtained their Act, they sent to Mr. Sugg, and asked him to give them a proper 15-hole argand burner with a 7-inch chimney; and when they went to Parliament for the 1868 legislation, they did not put the clause in, but asked Mr. Sugg to supply them with a burner that would comply with the old definition. He did this, and gave them a burner which not only diminished the central opening, which Mr. Grafton did with his ferrule and Mr. Sugg with his plug, but he also diminished the supply of air on the outside. It was not sufficient to diminish the air to the central point of combustion, because if they took an argand burner as a flat flame merely bent round into a circle, they got combustion in the centre, instead of an unlimited excess of air from each side. It was not sufficient to reduce the air in the centre—there was the outside to be considered; and in the Brentford burner, Mr. Sugg, without any particular instructions, regulated these things so that the Wandsworth Company had for years been testing the gas with a very scientific and very good burner. When it came to the pinch, having a Bill before Parliament, whether they preferred the South Metropolitan clause of burning a 16-candle flame with the No. 1 argand, or whether they would have Mr. Grafton's ferrule, Sir Frederick Bramwell's cone, or the Wandsworth burner, they found that the last was a great deal ahead of all the other suggestions. Nearly thirty years ago, Mr. Sugg read a paper pointing out that each quality of gas required a different burner; and he exhibited at the time of the Paris Exhibition in 1857, burners which were highly commended and prized, the reports on which appeared in the "Journal of Gas Lighting" in 1868. So long ago as that, Mr. Sugg knew that different qualities of gas needed different sorts of burners. What did the experts, to whom a somewhat joking reference had been made as to the imperfect way in which they tested gas, do? They allowed the Companies to come to them for advice; and in going to Parliament, they put into their Bill the No. 1 "London" argand, though some of them were making 13, some 14, and others 15 candle gas. They certainly ought to have known better. If they had sent to Mr. Sugg at that time, he would have said: "No; let me give you a 'London' argand suitable for testing 14-candle gas." To his surprise, on examining the question for the purpose of the parliamentary inquiry, he found there were, under the ordinary Act of Parliament, companies supplying 14 or even 13 candle gas with the No. 1 argand burning 5 cubic feet per hour exactly. That 5 cubic feet was arrived at in a most peculiar manner. Nobody thought that some special illumination was to be got from 5 cubic feet; but this quantity was 1-20th part of 100, and 1-200th part of 1000, and therefore it was a convenient measure. It was thought to be necessary to have something by which the consumer, when he was going to buy 1000 cubic feet of gas for 4s., should be able to know how many candles he was going to get for it. It was therefore convenient to say that from 5 cubic feet one could get an illuminating power equal to so many candles, but *non constat* that one would burn exactly 5 feet. There were one or two things in which he agreed with the writer of the paper, particularly as to the aërorthometer, which was an instrument for giving both the thermometric and barometric pressures. It was a very useful contrivance to save the examiner a little time; but it was frequently back in Mr. Sugg's hands for repair. The table which showed the comparison of the Wandsworth burner was correct. It was well established by Mr. Hunt, Mr. Carpenter, and himself, who signed a joint report on the tests, that with these three or four varieties of burners they all came to just the same result. The figures were given to the London County Council and the Board of Trade, showing that, on the whole, the Wandsworth burner was the best. He thought Mr. Grafton would have to admit that it was a great step towards the improvement of the "London" argand burner when they had a diminished illuminating power to test with it to check the air supply; but it was not so good as checking on both sides of the flame, inside and outside, as the Wandsworth burner did. Professor Lewes had that morning shown the correspondence between calorific power and illuminating power; and, referring to a paper which he (Mr. Jones) read last year before the sister Institution, they would see that the experiments

he there described, which were very numerous, led him to the conclusion, in spite of not having at command burners suitable for 10 and 12 candle gas, that there was a law of affinity between these two qualities of gas. He had, in fact, when he got down below 14-candle gas, to take the ordinary brass argand and ream out the gas-way holes to make the gas supply larger, and for 10-candle gas he had to make them larger still—so increasing the gas-way that, with a constant air-way, they got rid of the difficulty of over-aëration.

Mr. Isaac Carr (Widnes) said he feared the remarks he had to make would not be received with much sympathy by the majority of those present. However, his opinions were based on his experience; and he could not, in the light of personal knowledge, accept or agree with much that was said in the paper and a good deal of what Professor Lewes had told them that morning. They were very seriously considering how they could increase the light of standard burners—how, by this trick and that, in manipulation, they could increase the amount of light; appearing to be oblivious of what was the effect of all this on the flat-flame burner common to the ordinary gas consumer. The author of the paper contended that gas companies were entitled to all the light the burner would give. If this were so, and if every consumer were to participate in it, he quite agreed. But was it so? The argand burner, which was brought out fifty years ago, was of no more use to the gas consumer to-day than it was when it was invented. To his mind, the proper view to take of this subject was to consider whether it was going to benefit the consumer. Surely he was of some little use to them, and ought to be considered. They would be of no use if there were no consumer; and if they had him, they ought to look after him and keep him, especially in these days of competition. The Crystal Palace Gas Company's Bill had been frequently referred to; and as he had occasion to make some investigations on this matter, he should like to tell the meeting what the effect of the alterations in the Bill amounted to as regarded the consumer. At the present time, the Company supplied 15-candle gas, tested in the statutory way by the "London" argand burner and with the prescribed rate of consumption. Now, 15-candle gas would, in a batswing burner—one specially designed by the South Metropolitan Company and distributed by them, an excellent burner—give a lighting efficiency of 2·6 candles per cubic foot. That was what the consumer got with 15-candle gas. Power had been granted by Parliament to this Company to reduce their standard by two candles, and at the same time to submit it to a method of testing to show the maximum light the burner would give—the full value, as set forth by Mr. Grafton, of what the gas companies were entitled to count—all the possible light which could be got out of the burner. What was the result with this particular gas when consumed with the special batswing burner recommended by the Company? They did not recommend the argand burner with which they tested the light, but they issued this flat-flame burner as being specially suitable. He found the effect to be a reduction from 2·6 candles per cubic foot to 1·7 candles, or a falling off practically of one-third in the lighting efficiency of the gas. This gas was alleged to be of 13-candle power if tested by the proper statutory method, which should be adhered to if there was to be any intelligible understanding of the expression "illuminating power." They could make gas anything. They could alter it in this, that, or the other way, according to the kind of burner used, or by putting on a mantle, or intensifying it, or doing anything they liked. But if they were to have any intelligible ideas as to illuminating power, they ought to maintain the present statutory method of testing. With regard to calorific value in relation to illuminating power, his experience in this matter had been limited to the Lancashire coalfields. But all his research work in this direction went to show that there was a distinct relation between the illuminating power and the calorific value of gas; and he said that the policy of introducing a low-grade gas not only punished the consumer of gas in the flat-flame burner, but to an enormous degree also in the case of incandescent burners, as well as the users of gas for cooking, heating, and motive power. This was proved by the fact that the make of incandescent burner which was applicable in England was of no use in Scotland, because of the different quality of the gas. The English consumer of the lower-grade gas required larger orifices in the burner than the Scotch consumer; thus showing that there was a much higher lighting efficiency from gas of higher illuminating power in the incandescent burner. He might put in a word about his own gas at Widnes, as it was known to be sold at a very low price; but that was not done at the expense of the quality. In his opinion, had these low prices been introduced at the expense of the quality, the gas consumer would have been very much worse off. Taking three large London Companies, there was a considerable difference in the prices of gas, amounting, he believed, to as much as 8d. or 9d. per 1000 cubic feet; but the cheapest light in London at the present time was that sold at the highest price—that of the Gaslight and Coke Company. As a consumer of gas with the flat-flame burner, he should consider himself better off with the gas of that Company than with that of any of the other Companies selling at a lower price. He knew that his remarks would not be generally acceptable; but they were the result of his convictions. He regarded this matter of low-grade gas as a retrograde step—a step which their competitors would not be slow to take advantage of. Enrichment to-day, notwithstanding what had been said to the contrary, was cheaper and more easy of application than ever; and while they were in a position to give the consumer a good, and, from his point of view, an economical quality of gas, it was their duty to do so. This was the best way of preserving their business, and keeping their competitors at a distance.

Mr. William Sugg (London) said the paper would be very useful in showing the difficulties they had to contend with on the question of testing the illuminating power of gas, and the author deserved great credit for the careful and painstaking manner in which he had prepared it. But as regarded the question of illuminating power and testing, there could be no question about this—that the Gas Referees had the power of fixing the manner in which gas should be tested; and all they could say, whether they adopted the right theory or the wrong one, would not affect the question in the least. Probably a Committee would be appointed by the Board of Trade to go fully into the question; and this would, no doubt, lead to an improvement in the mode of testing, dealing not only with illuminating value, but also with calorific value, which evidently was becoming of greater importance. Though the paper did not touch upon this subject, it brought forward this point—that the present difficulties, which the author strove to overcome by altering the burner, were brought about by the fact of there being gas which was not made from coal only, but also water gas, and mixtures of the two. They all knew there was a great difference in the illuminating power of such gas tested with the present argand burner; because if they worked it in the way the Gas Referees prescribed—the illuminating power raised to 16 candles—that satisfied one requirement, and it brought the gas up to a proper point at which the air supplied to it was sufficient for its combustion and the production of 16-candle light. But if they had to test gas of poorer quality, they must naturally not have the same burner. Many years ago the Gas Referees adopted the argand burner for 14-candle gas. There was then a "D" argand the same size as was now used for 16-candle gas; and he suggested that if they tested 16-candle gas with it they ought to make a proper 16-candle burner. They then found that, by putting 2 inches on to the chimney, they could burn the gas at the rate of 5 cubic feet an hour very well indeed. But, of course, it sacrificed the gas—it brought down the illuminating power. The Referees would not have that; and they left the burner as it was—adopting the one they used for 14-candle gas, and putting a ring round it so as to carry a 2-inch chimney instead of the $1\frac{5}{8}$-inch formerly used. If they had done this, there would not have been much question raised at the present day about testing either 14 or 16 candle gas, because they would have had proper sized "London" argands fitted, and each of the burners would have been in the same proportion, and have given the illuminating power correctly. But at the present time the 16-candle gas had too much air for the lower quality of gas; and when they came to a mixture of water gas and coal gas, the difficulty was increased in this way—that the flame to give 16 candles with water gas, when there was a large quantity of carburetting material in it, only gave a flame of about 2 inches. Of course, the flame was over-oxidized; and if they reduced the quantity of air in the centre aperture of the burner until they had the right quantity for this quality of gas, the flame would be longer,

and greater illuminating power would be obtained. But the principle adopted by Mr. Grafton, of putting a little collar in the inside of the bottom, was not so good as having a small peg right up through the middle of the burner. In this way they made the flame steady; but if they did not do this, any little draught caused the flame to go round, shoot up in points, and become very unsteady. Even the smallest pin put up in the inside of the burner made an improvement; but if they regulated the quantity of air coming to the burner by the central peg, instead of by closing the bottom, the air was directed, as it should be, to the side of the flame, and the exterior cone on the outside of the combustion chamber directed it to the outside of the flame. Clegg and Grafton, in 1815, made a burner with a regulating opening to screw down, somewhat on the plan Sir Frederick Bramwell proposed to Mr. Jones to shut out the air, only they got the regulation by screwing the cone up into the bottom, and Clegg and Grafton put their regulator at the top, and screwed it down into the inside of the burner; but it came to the same thing—the regulation of the air. If it was regulated in this way, so as to produce a steady flame, it was what was wanted. If the flame went up and down all the way round, it was longer in one part than another, and a satisfactory reading could not be obtained. An average had to be taken, because the flame was unsteady. But if they had a steady flame, it could be much more accurately read. Mr. Grafton had given in his paper a great deal of information which would no doubt be useful to those who were not in the habit of carrying out tests of gas; but with regard to making any alterations in the mode of testing, they must depend on the Gas Referees and their scientific advisers.

Mr. T. S. Lacey (London) said he was rather disappointed to find that a paper with so comprehensive a title was practically confined within such narrow limits. He could fully understand the importance of the question of testing gas as applied to London and other places where alterations in the standard were being effected, that made it of great importance that the manner in which gas of from 13 to 16 candle power was tested should be carefully investigated, in the interests both of companies or corporations and the consumers. It necessarily limited the scope of the paper to lines which were concerned purely with the exactness of testing rather than with photometry in general. It seemed to him that the paper had been written to show that the method of using the argand burner was not fair to the companies who had their standard reduced, and that it would be preferable to go back to the 5 cubic feet rate, and adopt a burner of which the efficiency should be fairly equal for the different qualities of gas. However this might be, there were two views which could be taken—one was the way in which illuminating power should be tested for statutory purposes; and the other the way in which it should be tested for scientific investigation. The 5-feet rate he personally should be glad to get rid of in favour of the table photometer, in which the gas was burnt giving a light of a constant value, and a flame approximately of constant length. They had arrived at a system by which they could measure illuminating power by the quantity of gas required to produce a certain light. This seemed to him to be an intelligible and simple system of estimating it. If they were going to take the constant rate with different gases, of course, the burners had various efficiencies; and it would not be fair to gas of different illuminating power. It seemed simple and intelligible to have an argand burner for a 16-candle light, and estimate the value of the gas according to the light obtained. This was very convenient. If they adopted this system for gas varying in quality from 14 to 19 candles, they would know what they were doing. But if, not for the purpose of statutory testing, but of thorough investigation, they were going to change the burners, and have one of this kind and one of that, he did not see how it would be possible to interpret the results of experiments made with different gases. He therefore thought that to adopt a method of constant rate, instead of a constant light, or some other system a little more intelligible, would be taking a long step backwards. The table thermometer test was a useful thing for one particular purpose, but not for anything else. If it was constructed for the 16-candle light, and used in the way originally intended, it was an instrument in which one had some confidence. It treated the gas fairly. Mr. Grafton in his paper stated practically that he had now a burner which would give, at the rate of 5 cubic feet per hour, results fairly comparable for gas of between 13 and 16 candle power. He (Mr. Lacey) thought it would simplify things, and lead to less misunderstanding, if a burner were adopted of which the efficiency was the same for all qualities of gas; but this was hardly probable. He thought it was quite unnecessary, as the public were not so unintelligent as not to understand that the light obtained was based upon the quantity rather than upon the quality of the gas used. To him the question was one of much interest, and was not merely confined to testing, to which they were obliged to give a great deal of attention, because it was a matter of very much importance intrinsically, though it really was not of so much moment to the public as was generally supposed. The question of photometry was very important with regard to the quality of the gas supplied to large high-power lights. Possibly some of the members had heard of a paper read by Dr. Fleming at the Institution of Electrical Engineers, in which the ground of photometry as applied to electric lighting was covered in a manner which did him great credit.* In this paper the question of testing light of different colours and light coming from burners and electric lamps at different angles was dealt with; and it was of great importance, now that they had to compare their light with those produced by other means, that they should not only be able to measure it in a horizontal flame, but also to take it all round. This was a question of very great difficulty; and he thought the measurement of light in incandescent and other burners in a really scientific manner would be an object quite worthy of the attention of any Committee of Investigation that might be appointed by the Institution. A little work done in this way would be certainly well worth doing.

Professor Lewes said he did not think he had anything to add to the interesting discussion, but there was one point which might be still further emphasized—viz., that, after all said and done, there was nothing much the matter with the "London" argand burner. It was the 5 cubic feet rate which was the demon of the play; and if they were to take the "London" argand, and after burning the gas in it until, as the Referees and Mr. Charles Hunt had shown in the earliest years of scientific gas testing (about 1869), they got the largest amount of light from the particular gas, they would find it was fairly constant over a very wide range. This method of burning gas made the "London" argand perfectly fit for almost every gas between 11 and 17 candles. Mr. Grafton had done his work exceedingly well; and he (Professor Lewes) could bear testimony to the fact, from a very long series of experiments, that his burner did give the results he claimed for it. But at certain points—14-candle gas, for instance—the Wandsworth burner was better even than the Grafton. There was this curious fact, however, that if they took the Wandsworth, which would give the best results with 14-candle gas, and went to lower candle powers, it would begin to sin in the same way as if they kept the constant rate of flow with the "London" argand, but below 16 candles. If they were going to keep the constant rate of flow, they must have a new burner for every candle power; there was no getting away from that fact. The reason why he was inclined to use the "London" argand was that it was at present in every gas-works where there was a photometric apparatus; and if they would alter the definition of the rate of flow, and say that a 14-candle gas, burning at the rate of 5·71 cubic feet an hour, gave a light of 16 candles, then they would do away practically with the whole of the trouble, and would be able to compare the tests in every gas-works in the kingdom.

Mr. Grafton, in reply, said he would deal with the criticisms in the order in which they had been made. Mr. Webber said the standard burner must not be interfered with, because it was the standard. He (Mr. Grafton) could only retort by asking why it was that the 10-candle pentane standard had been substituted for candles. One could be put aside equally as well as the other when it was found that it did not do its full duty. With regard to the uncertainty of the results, that, of course, went without saying. They had mixtures of carburettted water gas used, which from day to day could not always be relied upon. They might be of 12, 25, or 30 candles, and this brought in uncertainties, no matter what burner they had. Having to get a mixture of carburetted water gas, they were bound to have slight differences. This was why a small amount of

* See "Journal," Vol. LXXX., p. 1610.

adjustment was effected by shortening or lengthening the chimney to bring about the desired result in each particular case, whether the gas was of 16, 15, or 14 candle power. If they could not agree among themselves as to the nature of the burner to be used, how could they expect any better treatment from their opponents? They must agree on a burner among themselves first. With regard to the external and internal air supply of the Wandsworth burner referred to by Mr. Jones, he might point out that it was the internal, not the external, air supply of argand burners that governed the amount of light obtained from them. This was easily proved. They could take a "London" argand, close the inlet of the air supply, and get the same amount of light; thus showing it was not necessary to have a second supply of external air, as was done in the Wandsworth burner. With regard to the length of the chimney in this burner, one of the reasons they sometimes obtained a better result than with the improved argand was that different coals yielded gases of different composition; and the flame values and lengths of these particular gases varied in themselves. One day the flame might be only 3¼ inches, whereas the next it would be 2¾ or 3⅛ inches, and this necessitated a change of chimney very often. With regard to the Wandsworth burner, it was so adjusted that it would burn 14-candle gas nicely with a 7-inch chimney. Reducing it by an inch in length, making it 6 inches, would cause it to smoke at once; or even if it were 6½ inches in many cases, with different kinds of gas. This was why it was thought that, by improving on the "London" argand, they would be retaining the old standard with a slight amount of modification in adjustment by using a shorter or a longer chimney as the case might be, according to what gas had to be consumed. In regard to Mr. Carr's remarks with respect to 15-candle gas in a flat-flame burner, he was sorry that the burner spoken of in the paper had not been touched upon; but the whole discussion seemed to be directed to the argand burner rather than to other methods of testing. The shortcomings of the apparatus sometimes brought about changes which they attributed to the burner rather than to the apparatus; but in many cases it was due to the instrument itself. Really 50 per cent. of the variations found in photometry were attributable to the variations mentioned in the manipulation of the standard table photometer, and in the place in which it was used. If they had the conditions always the same, they would get the same result, no matter whether the apparatus was a portable or a fixed one. To say what was the proper burner was to say that they must find one; and it was with this idea that he had tried to carry out his investigation. The only way that appeared to him to be the proper way of burning gas was by shortening or lengthening the chimney; and having once arrived at the sensitive point of the burner—and the most sensitive point of the "London" argand was when the internal aperture was 0·3-inch—by slowly increasing or decreasing the length of the chimney they got either an improved or a worse result. With regard to the statutory method mentioned by Mr. Carr—and the same remark applied to Mr. Lacey—he overlooked the fact that he (Mr. Grafton) did not recommend a statutory rate of 5 cubic feet, but meant approximately; just as, below 16 candles, approximately burning 5 cubic feet of gas per hour, the time at which the official apparatus could be used was two minutes. If the gas was burnt for two minutes, it was exactly 5 cubic feet an hour. It should be the same with regard to 14 or 13 candle gas, as the case might be. It was because burning the gas—say, 13-candle—at what might be called the normal value of 16 candles, that it was misleading to the ordinary consumer, who thought the gas was being doctored, because it was burnt with greater vigour than it should be. For flat-flame lighting, he should imagine, 2·6 candles was very good. He had distinctly shown in his paper that 15-candle gas, viewed in the ordinary official way, gave 15·15 candles with a flat-flame burner. It actually gave more than with a "London" argand—showing that the consumer was not robbed in the way Mr. Carr had stated.

Mr. CARR: Why not adopt that as the statutory burner if it gives a better result?

Mr. GRAFTON said this was a point mentioned in the paper to show that the official burner did not give the full duty of the gas. The full value should be given, not a lower return than could be obtained by the consumer with a flat-flame burner. His point was not whether it was a question of supplying low or high quality gas, but of testing any gases; and they should get the full value out of the gas by not sending out 15-candle, and finding it exceeded 16 candles. He did not want to be sending out gas 1½ candles more than the burner represented. It meant, first, that they could not get such big makes from the coal, or could not use so much blue water gas; and, secondly, that they were robbing themselves. With regard to Mr. Sugg's remarks, the Referees had prescribed a standard method. They had a 14 and a 16 candle flame; and naturally, since they prescribed a 14-candle flame for Commercial gas, they would prescribe a 13-candle flame for the Crystal Palace gas. It was for this reason that he based his paper on this determination of the Referees. They had gone to 14 candles, and therefore they might go down to 12 or 10 candles burning approximately 15 cubic feet of gas. This could be done, on having once arrived at the sensitive point, by shortening or lengthening the chimney. This was not the case with the Wandsworth burner, or with the one with the peg up the centre. He narrowed the aperture at the bottom of the gas inlet. Mr. Sugg used a peg, which he (Mr. Grafton) did not consider so satisfactory as regulating at the bottom. He had tried it at all points up to the top; but he found the bottom was the best, because when the gas once passed that it travelled at a slower rate, which was necessary for economic combustion. By having a peg, they obtained a continuous rapid current all the way through the steatite ring. In some hands the peg got slightly out of the centre, and then the flame became distorted, and was no longer cylindrical. The internal air supply gave the luminosity; the external supply gave the stability or shape to the flame. The burner would never be found to give just the true light at any time. The gas one day might be exactly 16 candles; but the next day, through a change in the percentage of water gas, or the use of a different class of coal, it might be 0·2 candle underrated. Small errors could be neglected; but when they came to 0·8 candle or 2 candles, it made a serious difference. In reply to a remark by Mr. Lacey, he might say that the efficiency was gained by a slight adjustment in the argand by the length of the flame, suiting it to the particular grade of gas. It was with this object that he went into the matter; and the new burner suited the requirements. It was found that the "London" argand could be remodelled to give what was needed, not only by an adjustment of the chimney, but by altering the central air supply. Mr. Hunt had given definite lengths for the flame values. Referring to the heating values given in Table IV., they must not, if they were going to have a heating value standard, claim too high a figure. The line shown by Professor Lewes was very fair; but it did not quite follow whether it was with a 12-candle or a 16-candle flame in a "London" argand. It was making the gas too good to have 12-candle gas rated up to 15 candles; he found the result too beneficial to the illuminating power. The gas should be rather poorer—from 40 to 50 B.T.U. This made a considerable difference to the result obtained from the coal carbonized. Dealing with quantities of air—a question raised by Mr. Webber—he was not quite clear as to the theory of the actual figures. He only put this matter in to raise a point for discussion—in fact, he found it necessary to put it in the way he had done in order to make people think about it. If they went down to 1 candle they would not require one-sixth of the air; but what this clearly showed was that, strange to say, it was right as far as he had gone, which was as low as 14 or even 10 candles. Professor Lewes, in one of his Cantor Lectures, gave a matter of 13 per cent. more air in the "London" argand at the 5 cubic feet rate than was necessary for the economic or perfect combustion of 14-candle gas. His own practical figures, measured on the improved argand burner, were 12·98 candles; bearing out his calculation from the theoretical analysis of the gas. It was found that he had a gain of 0·61 candle in the illuminating value with his burner compared with the other; whereas the Wandsworth burner was not usable in this particular case. The chimney was full, and the flame tailed above it to the extent of half-an-inch. He should like to point out one thing which was emphasized by Professor Lewes—that the amount of luminous flame would remain about the same for 16-candle gas as for other qualities, with the Wandsworth burner or with any possible burner, of 4 to 5½ inches in length. This was also taken into consideration in the improved burner, so as to secure as nearly as possible a unit area. He thanked the members for the way they had criticized his paper, and expressed the hope that it might really be a step

towards the furtherance of a better method of arriving at the value of gases.

In the course of the proceedings the following day,

Mr. WEBBER asked leave to make a slight addition to the remarks which he had made the previous day on Mr. Grafton's paper. He was then called upon rather suddenly, and was not prepared to make any positive addition to the information in possession of the Institution; but he had procured this since, and wished to bring the facts before the members. They could not avoid (in talking of intensified gas lighting, or any other matter) starting with the assumption that they were dealing with gas of a certain quality. They talked about 14-candle gas, or whatever the case might be. Now, he had a few facts which showed how much they might misunderstand one another, and how much uncertainty prevailed as to what was 14-candle gas—especially gases called 14 candles—and under. When they came to 16-candle gas or above, there was not perhaps so much uncertainty, especially if it was pure coal or cannel gas, because it was more in accordance with the use of the "London" argand burner, which was made for it. He had found a sample of light coal gas, quite pure, made without overrunning the exhauster, and nominally anything between 13 and 14 candle power—a gas made from good Durham coal. Tested by the "London" argand burner, burnt at the 16-candle rate calculated from the rate of consumption, it was 12·8-candle gas at 5 cubic feet per hour. With a 3-inch flame in the same burner, it yielded a light of 13½ candles, and then worked out to 11·9-candle gas for 5 cubic feet. Burning at the 5 cubic feet rate, it only burnt to a 2⅜-inch flame, and yielded 10½ candles at the 5-feet rate. The question was: What was the illuminating power of this gas? The incandescent illuminating value of the same gas in a Welsbach "C" burner was 20 candles, or 100 candles at the 5 cubic feet rate. That was all the same gas.

Mr. GRAFTON, referring to these later observations, said Mr. Webber had given, if he rightly understood him, coal gas unadulterated, as he preferred that word, with air or anything else, and it gave, with a 16-candle flame combustion, with a "London" argand, 12·81 candles at 5 feet an hour. If, however, he adjusted the flame so as to have a 3½-inch or 3-inch flame, he got 11·9 candles. He was sure that there was something radically wrong with it. At 12·81 candles, with a 16-candle "London" argand, for all intents and purposes, it was a 3-inch flame. This was proved not only by his own work, but by Professor Lewes. By adjusting the rate so that it should only burn 5 feet and no more, the quality dropped to 10·5 candles. If such gas had been burned in an improved "London" argand, he would have got less than 5 feet consumed, and more than 12·81 candles out of the gas. How was it the heating value did not correspond with the 12·81 candles as shown on the curve given by Professor Lewes?

THE LEWES PROCESS AT TIPTON.

By SIDNEY O. STEPHENSON, of Tipton.

Being the first in this country to adopt the Lewes process for the utilization of blue water gas on the full working scale, as against the experimental, it has been intimated to me that my experiences and results of the system would be of interest to the gas profession generally and to this Institution in particular. The continued growth of Tipton, and the increased demand for gas, had rendered necessary an extension of our manufacturing plant prior to my appointment. Our borrowing powers were, however, exhausted, and the Council were unwilling to go to the expense of obtaining fresh powers if it could be avoided. This made it therefore more than ever necessary to increase our plant at as low a cost as possible consistent with efficiency. The Gas Committee had already investigated the claims of carburetted water gas on the Lowe system; but while fully recognizing the merits and advantages of that process, they found that the cost of its manufacture at Tipton would exceed that of coal gas, and it was therefore rejected.

Shortly after this, at the Glasgow Engineering Congress, I had the pleasure of listening to Professor Lewes's paper on the "Utilization of Water Gas in the Destructive Distillation of Coal." Professor Lewes had for some time advocated passing blue water gas through the retort while the coal distillation was in progress, more particularly for the first three or four hours, in order to act as a carrier for some of the richer and lighter hydrocarbons, which are lost to the gas in the usual working—being in some cases condensed into the tar and in others decomposed, resulting in naphthalene, stopped pipes, and carbon deposited in the retort. He was of opinion that the blue water gas would not only act as a carrier for these hydrocarbons, but that a constant stream admitted at one end of the retort, and the whole bulk of mixed gas drawn off at the other end, would keep the coal gas constantly moving forward as it was evolved, preventing any stagnation in the middle of the retort, and consequent decomposition of hydrocarbons.

In his paper at Glasgow, Professor Lewes recounted how an experimental trial of his process had been made at the Crystal Palace Gas-Works; the blue water gas being obtained from a plant erected by the Economical Gas Apparatus Construction Company, Limited. These experiments might be considered successful and as proving the Professor's theory; seeing that the water gas picked up a large share of its enrichment by this means, and that it also resulted in a net gain in the make of coal gas, ranging from 200 to 1000 cubic feet per ton. Reporting these matters to my Committee, they felt that this would be an ideal method of extending the manufacturing capacity of our works, as not only would it provide increased manufacturing power, but would also economize the cost of manufacture both in

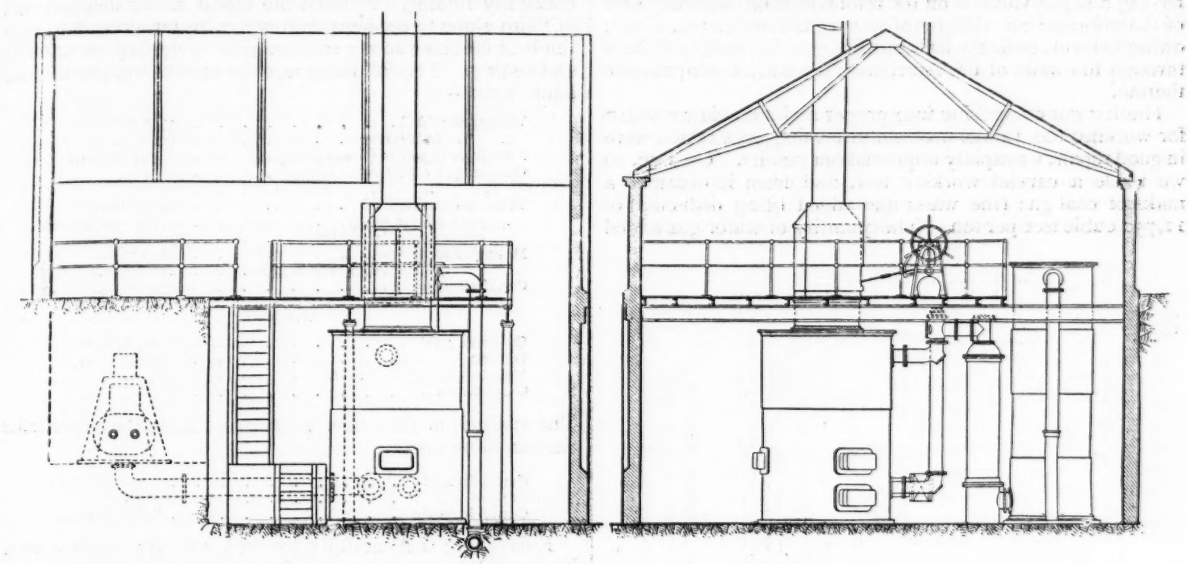
FIG. 1.—PLAN OF THE TIPTON GAS-WORKS.

itself and the coal gas. After due inquiry and investigation, therefore, they decided to adopt the process.

The next question, of course, was as to what plant would be necessary. There could be little hesitation as to the water-gas plant. A blue gas only being needed, the Dellwik plant, of which I had had some little experience previously at West Bromwich, giving a high make per ton of coke—viz., 70,000 cubic feet when in constant work—was cheaper in capital cost, simpler to work, would produce the blue gas considerably cheaper, and, on account of its simplicity, would cost less in maintenance and repair than any other water-gas plant on the market. A Dellwik plant of 300,000 cubic feet per twenty-four hours capacity was therefore decided upon. (See fig. 2.) As we were well off for storage room (one holder of 330,000 cubic feet, and two of 160,000 cubic feet each capacity), one of the smaller holders (fig. 1) was made over to the storage of the blue water gas; and a disused station meter was put in repair and utilized to measure the make. A rotary meter was ordered for measuring and regulating the quantity of blue gas admitted to the retorts.

The connections in the retort-house had now to be considered. Our settings are Winstanley's regenerators, throughs, with seven retorts in a bed, self-sealing mouthpieces, and the hydraulic main was fitted with a form of anti-dip, in which the dip-pipe is cut in two and the lower half made to drop into the liquid when the retort was charged, thus allowing the gas to pass off across the top. I

FIG. 2.—SECTIONS AND PLAN OF THE BLUE WATER-GAS PLANT.



found this arrangement to answer very well for about three weeks after a bed was put on; and then the working parts began to pitch up and stick fast. Unfortunately, some would stick while up and others while down, with the result that there would be a seal of about 3 inches on some, and the others would be unsealed. I could not look on this as an altogether satisfactory state of affairs. The ascension pipes tapered from 7 inches at the bottom to 5 inches at the bridge-pipe; and we were not provided with any such luxuries as separate lengths of hydraulic main to each bed, with a foul main running behind. The hydraulic main was at first made in one length, the full run of the house, and serving the whole eight beds; the gas being taken off the end through a 9-inch pipe, which, however, subsequently expanded into a 12-inch. It was evidently considered unwise at the time the Tipton Gas-Works were built to make connections to the retort-bench too big, or to give the gas too ready a means of getting away to the holder. I believe the hydraulic mains gave my predecessor, Mr. Hughes, so many sleepless nights that he eventually cut them in two, so as to each serve four beds only, and took the gas off at both ends of the house. This relieved the trouble a good deal.

Now the Lewes process necessitated my passing the water gas in at one end of the retort and taking off the whole bulk of gas at the other end. To do this, I had therefore to cut off the hydraulic main altogether on the side where I introduced the water gas. (See fig. 4.) It was evident that in doing this I was not only giving the already over-small connections on the other side double the quantity of coal gas, &c., to deal with, but was also going to add to this a large bulk of water gas. I would have liked to put in larger connections; but this would have involved too great an expense. At the same time, it was very necessary that I should give the gas every possible chance of getting away. I had little hesitation in deciding to convert my hydraulic into a dry main. It would present the least possible opposition to the passage of the gas; and I had had sufficient experience of its working to appreciate the other advantages which it presents over the hydraulic—viz., an increased yield of gas and a slightly better quality.

In order to make the conversion as cheap and simple as possible, I connected a 4-inch pipe to the bottom of the hydraulic, to take off the tar and liquor as they condensed down, and fitted this pipe with a valve for flushing purposes. (See fig. 4.) In place of the more usual butterfly valve on the bridge-pipe, I adopted a valve I had seen at Preston—designed, I believe, by Mr. Green. It consists of a rod passing through a stuffing box down the centre of the dip pipe, with a disc attached to the end; the disc being drawn up against the dip when it is desired to close off the ascension pipe. (See fig. 5.) The other end of the rod is attached to a lever having its fulcrum on the centre of the bridge-pipe. The valve is operated by the stoker with a long rod having a double hook on the end. I cannot say that I like this form of valve as well as the butterfly, as pitch and thick tar are apt to drop on to the disc. But it was the least expensive form of conversion, requiring only the valves, stuffing-boxes, and new dips. The only other alteration necessary in the retort-house was the connections for the water gas. I had a 6-inch pipe run along the front of the ascension pipes, just above the top mouthpieces, and connected in the centre to the pipe from the rotary meter. From this, 1-inch tubes were taken, fitted with cocks, and connected into each ascension pipe. (See fig. 3.)

The plant was ready for working, and was started, in December—the worst time of the year for starting a new thing. If we had expected all to run smoothly from the commencement, we were certainly doomed to disappointment. We had started taking the gas off on the one side only, through the dry main, two or three days before the water-gas plant was started; and as we had a run of fine coal of a sooty nature coming in just then, trouble commenced in the shape of blocked ascension pipes, and thick tar, which quickly blocked the devious tar-pipes. When the water gas was admitted, a further surprise was in store. The quantity was registered at the rotary meter; but there was no appreciable gain in the quantity of gas passed by the station meter. This was discovered to be largely due to leakages about the connections; but there was still a discrepancy. I then discovered that there was back-pressure on the retorts, although, owing to the cramped connections, there was no back-pressure showing at the gauge on the foul main. I therefore had a gauge attached to one of the ascension pipes, so that I could make sure of there always

being a slight vacuum on the retorts. The reason for having a slight vacuum on the retorts will be obvious. One of the principal constituents of water gas is hydrogen, which, owing to its exceedingly light specific gravity, readily diffuses through the walls of the retort with the least back-pressure therein.

Having got everything into proper and suitable condition for working the Lewes process, and using beds which were in good repair, we rapidly improved our results. On Dec. 19 we made a careful working test, and from it obtained a make of coal gas (the water gas added being deducted) of 11,750 cubic feet per ton. The quantity of water gas added

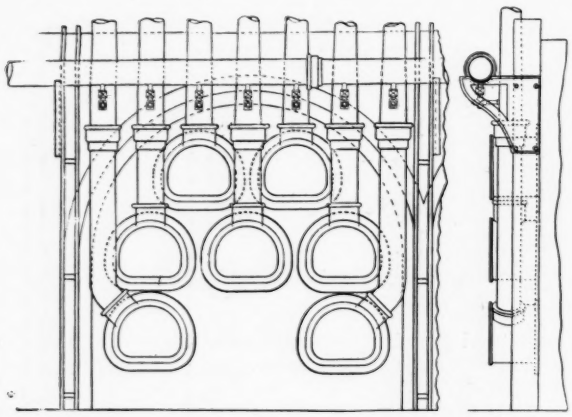


FIG. 3.—CONNECTIONS FOR LEWES PROCESS.

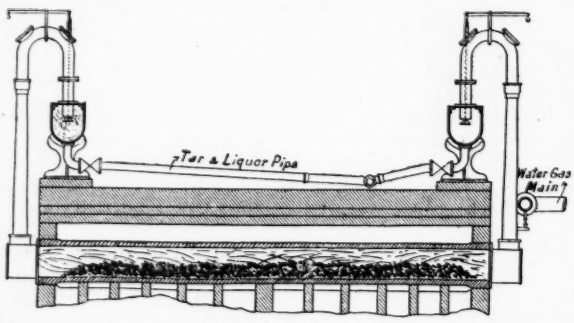


FIG. 4.—SECTION OF RETORT, SHOWING THE METHOD OF ADMITTING BLUE WATER GAS.

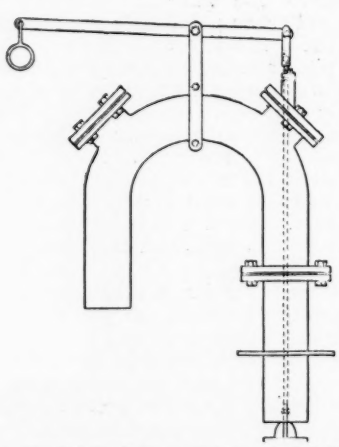


FIG. 5.—BRIDGE-PIPE, SHOWING THE DRY-MAIN VALVE-ATTACHMENT.

was 37 per cent., and the benzol used for enrichment 0·079 gallon per 1000 cubic feet of the mixed gas, or 0·29 gallon per 1000 cubic feet of water gas. Excellent as I considered this result, it was not long before we surpassed it. I had the retorts kept in good repair and as tight as possible, and careful attention paid to the working of the exhauster, and for the week ending Feb. 4 found that, with an admixture of 7½ per cent. of water gas, we had a net make of coal gas of 12,113 cubic feet per ton. On Feb. 24, Mr. H. F. Hills came to Tipton to make a careful test and to check my figures. I placed the works at his disposal, and left him alone to conduct the tests in his own way, and with the best facilities at my command for weighing, measuring, and testing. The following was the result for a twenty-four hours test:—

Water gas added	37·5 per cent.
,, ,, in mixture	27·2 ,, ,,
Illuminating power (unenriched)	11·13 candles
Calories per cubic foot. Gross	130·5
,, ,, ,, Net	118·8
Total coal carbonized	31·07 tons
,, purified gas made	528,000 cubic feet
,, crude water gas added	144,000 ,, ,,
Make per ton, total	16,993 ,, ,,
,, ,, deducting water gas	12,359 ,, ,,
Candle feet per ton	37,826 ,, ,,

Analysis.

Carbonic acid	0·2 per cent.
Oxygen	0·2 ,, ,,
Unsaturated hydrocarbons	2·3 ,, ,,
Carbonic oxide	15·9 ,, ,,

The analysis of the crude water gas during the experiment was as follows:—

Carbonic acid	4·2 per cent.
Oxygen	*nil.*
Carbonic oxide	38 2 per cent.

Everything was carefully checked, and the result cannot be regarded as otherwise than satisfactory. It is even more so than Mr. Hills' figures show; for it will be observed he makes no correction for the 4 per cent. of carbonic acid in the crude water gas removed by the lime purifiers. If this correction be made, it leaves 138,240 cubic feet of water gas in the total purified gas, and brings the make per ton of net coal gas up to 12,544 cubic feet. Of course, this experiment was conducted under the best possible conditions, and with every care and attention; the retorts being drawn and charged most expeditiously, so that as little gas as possible might be lost. But I could not see why, with coals of similar quality, we should not maintain a coal-gas make of 12,000 cubic feet per ton. This I have so far succeeded in doing; our figures for March and April being as follows:—

Water gas added, percentage	12·92 per cent.
Total coal carbonized	1,517 tons 9 cwt.
Purified gas made	20,702,000 cubic feet.
Water gas added	2,369,000 ,, ,,
Make per ton, total	13,642 ,, ,,
Make per ton, deducting water gas	12,081 ,, ,,
Illuminating power (enriched)	15·25 candles.
Benzol used per 1000 feet mixed gas	0·072 gallon.

I am aware that these results have occasioned much surprise; and I am asked to account for the high yield of coal gas. I attribute it to two causes: Firstly, the prevention of decomposition of hydrocarbons, and, secondly, that a portion of the tarry vapours are permanently converted into illuminating gas; the water gas in both cases acting as a useful carrier. The fact that I have obtained this large increase in volume of coal gas with the addition of small percentages of water gas, and that the yield of coal gas is not greatly further augmented by increasing the percentage of water gas, seems to confirm the theory of the gasification of tarry vapours. Certain it is that the water gas not only gathers a part of its enrichment in the retort, but, in doing so, increases the yield from the coal, and that to no inconsiderable extent. Whether there would be quite such an increase in yield from single retorts 10 feet in length as in my case of 20 feet throughs remains to be proved; but I understand this will shortly receive trial at Rushden.

I may say that I have not recently had any trouble from naphthalene, either in or out of the works, and very little in the way of stopped ascension pipes or carbon deposit in the retorts. Very particular attention is paid to the working in the retort-house. The retorts are kept in good repair, good even charges are put in, as little time as possible is wasted in drawing and charging, good, but not excessive, heats are kept, one-tenth vacuum on the retort is maintained, and the dry main is flushed out twice daily. The coals used are mainly North Staffordshire, with a little Broughton and South Yorkshire—all good gas coals.

With reference to the question of comparison of costs between this process and ordinary coal-gas manufacture, I am afraid it is hardly possible to give reliable figures until I have had a full year's working of it. Such an item, for instance, as repairs and maintenance cannot be arrived

at in less time. There will be a saving, of course, on the latter item, and there will also be a saving on manufacturing cost varying according to the percentage of water gas used. Against this, there will be rather less of those kittle sources of income, the residuals, for sale. It will be obvious that the working of the process will pay better when the value of residuals is low than when it is high, particularly if the coal markets are also ruling high—a remark which applies to carburetted water gas as well, though in that case the oil market also affects the question.

The usual advantages of a water-gas plant, such as equalizing the variation in demand on the coal-gas plant, quick production of gas, &c., are presented by this process; and it certainly has the advantage of being cheaper in manufacturing, as well as capital, cost over carburetted water gas. Another advantage which the Lewes process possesses over carburetted water gas is that there is no trouble with oil tar—a trouble which, so far as I can gather, has not yet been satisfactorily overcome, the oil tar, which has a truly wonderful odour, condensing out where it thinks fit, not only in the purifiers, where it renders the oxide valueless, but even into the consumers' meters.

There is a still further advantage which the Dellwik water gas plant possesses over the Lowe type. The latter requires a skilled operator and assistant, whereas, so simple is the Dellwik plant, that an unskilled youth at £1 per week is quite capable of working it without fear of danger or mishap. As a proof of this, the boy whom we paid 7s. 6d. per week, on one occasion when my water gas maker did not turn up, after getting steam up and without saying a word to anybody, started to and made water gas for the remainder of the day, quite as well as the man could have done, and he has since repeated it.

My generating cost of blue water gas works out as follows:—

	Pence.		
Labour	0·68	per 1000 cubic feet.	
Coke for generator	2·20	,,	,,
Fuel for boiler	0·49	,,	,,
	3·27	,,	,,
Total benzol enrichment	5·98	,,	,,
Purification	0·88	,,	,,
	10·13	,,	,,
Less saving in extra make of coal gas	0·75	,,	,,
Total	9·38		

The plant has a manufacturing capacity of 300,000 cubic feet per twenty-four hours; but it is worked during the day shift only, and not every day. With this intermittent working, we do not therefore obtain the fullest possible make, but get an average make of 60,000 cubic feet per ton of coke. The plant is so arranged that one man is able to work it, and he is paid 4s. per day. The Tipton works is favoured with two levels, of which I took advantage in building my plant, so that the working stage is on the same level as the charging floor of the retort-house. The coke wheelers therefore wheel the necessary coke to the working stage of the water-gas plant as a part of their duties. I have charged the coke at 11s. per ton, the average value at Tipton.

Our cost of coal gas manufacture for last year is as follows:—

	Pence.		
Wages, coal, and other materials	17·26	per 1000 cubic feet.	
Purification	0·88	,,	,,
Repairs and maintenance	1·58	,,	,,
	19·72		
Less residuals	8·41	,,	,,
	11·31		
Management and office expenses	1·01	,,	,,
Distribution	1·27	,,	,,
Total	13·59	,,	,,

I may say, in conclusion, that all carburetting necessary is done at the outlet of the station meter, so that this cannot affect the figures as to volume.

In the course of the reading of his paper, Mr. Stephenson interpolated one or two statements which may be given here. He said that, as a result of a test made since the paper was written, he had found that the calorific value of the coal gas alone was 628 B.T.U.; with 20 per cent. of water gas, 584 B.T.U.—a reduction of 7 per cent. Another test he had made was to drop the admission of water gas, and weigh all the coal. Under such conditions, there was a reduction of 600 cubic feet in the quantity of coal gas per ton. Another interesting fact was that during the three months of March, April, and May of this year, there had been no material reduction on last year's working with respect to the quantity of tar, which was about 11½ gallons per ton. He had no means of testing its quality, as the Tipton works did not boast a laboratory in which such tests could be made. In regard to the cost of benzol enrichment, he explained that he had thrown the whole of it on to the water gas, in order to make the figures comparable with those given for the carburetted water-gas process, though properly only 4d. belonged to the water gas, the remaining 1·98d. being chargeable to the coal gas. He had not included "repairs and maintenance" in the cost, as he could not give that figure under a year's working. The item of purification was the same as for the coal gas last year; but ½d. would probably be found to be about the right figure for it.

Discussion.

Mr. A. E. Broadberry (Tottenham) said the members were all very much obliged to Mr. Stephenson for the trouble he had taken to prepare his paper. At the same time they were not bound to agree with him; and he (the speaker) really thought Mr. Stephenson had not very much advanced the subject he had treated. The first portion of the paper referred to matters which did not really concern the subject very greatly; then he mentioned that he had a gauge fixed to one of the ascension-pipes, so as to make sure of there always being a slight vacuum on the retorts. The reason for this would be obvious—viz., that one of the principal constituents of water gas was hydrogen, which, owing to its exceedingly light specific gravity, readily diffused through the walls of the retort with the least back-pressure. Now the specific gravity of hydrogen was certainly very light. But in water gas it was combined with other things which rendered the mixture heavy; and he did not see how Mr. Stephenson expected that water gas was going to diffuse through his retort any more readily than coal gas. Even if it did, he did not think he could say that water gas had a larger percentage of hydrogen in it than coal gas, more especially if he referred to Professor Lewes's analyses. The author gave a partial analysis of crude water gas which certainly indicated that there must be a good deal of nitrogen present; and his hydrogen certainly could not be so high as it would be in coal gas. Farther on he said: "Of course, this experiment was conducted under the best possible conditions, and with every care and attention; the retorts being drawn and charged most expeditiously, so that as little gas as possible might be lost." Then, going on to refer to the same subject, he said: "Very particular attention is paid to the working in the retort-house. The retorts are kept in good repair, good even charges are put in, good heats are maintained . . . and the dry main is flushed out twice daily. The coals used are mainly North Staffordshire, with a little Broughton and South Yorkshire—all good gas coals." From that, he (Mr. Broadberry) took it that Mr. Stephenson was exercising special care in his retort-house, working with dry seals, which he said produced an extra make of gas apart from the system he was describing; and he showed that he was working the retorts under a vacuum. He was paying particular attention to the work. All these things probably had more to do with the production of 12,000 cubic feet of gas per ton of coal than the system of introducing a certain quantity of producer gas into the retorts. A further matter to which he called attention was this. He said: "Another advantage which the Lewes process possesses over carburetted water gas is that there is no trouble with oil tar—a trouble which, so far as I can gather, has not yet been satisfactorily overcome; the oil tar, which has a truly wonderful odour, condensing out where it thinks fit, not only in the purifiers, where it renders the oxide valueless, but even into the consumers' meters." From this, they could gather that he admitted that he did not exactly know. But it was a great mistake, if he did not know, to throw out a suggestion that the oil condensed and injured the consumers' meters. He (Mr. Broadberry) had occasion very recently to investigate this subject, and not only looked up the figures himself, but asked a certain meter maker if he had experienced any difficulties in this way. He immediately said: "Oh, yes; certainly." There were certain works which he mentioned where for some time they noticed that the diaphragms of the meters needed renewal now much more

requently that they were making water gas. He asked him how long he had noticed this; and he replied: "For upwards of twelve months." He (Mr. Broadberry) then pointed out that the works he referred to had only started making water gas about six weeks prior to the day when he was speaking. This illustrated what he had just said—that these suggestions should not be thrown out without having accurate knowledge. The figures he had were these: They commenced making water gas at Tottenham in 1894, and he had taken out a list of the proportion of new diaphragms required in the repaired meters in 1892 (previous to making water gas), in 1897 (three years afterwards), and in 1902. In the first-named year, the proportion of new diaphragms required was 33 per cent. In 1897, it was 36 per cent.; and no doubt the opponents of water gas would have jumped on to that at once, and said it showed what water gas had done in three years. But when he went on to 1902, he found the percentage had dropped to 29; showing very clearly that water gas did not injure the consumers' meters.

Mr. D. T. Livesey (East Grinstead) said, notwithstanding the criticism Mr. Broadberry had passed upon the paper, he thought those who had to deal with small or medium-sized works would be much interested in it. In going through the figures, he found that for each ton of coal Mr. Stephenson received on the works, he could produce 56,000 cubic feet of gas. If one took the quantity of coke made, and reckoned that there could be utilized 10 cwt. per ton, it gave 42,000 cubic feet of gas to be made from each ton of coal fully utilized on the works, with 3 gallons of benzol, and gas of 15¼-candle power. This result would stand comparison with most of the work done at the present time. He thought Mr. Broadberry had failed to grasp the full meaning of the paper; for 42,000 cubic feet of 15¼-candle power gas from every ton of coal utilized on the works was almost a record—at all events, at the present, he did not himself know of anything that could touch it. At the same time a little explanation was necessary with reference to the question of the quantity of benzol used. The author gave the quality of the unenriched gas, when using 37·5 per cent. of water gas, as 11·13 candles; but, unfortunately, he did not give the quality of the gas when it had been enriched. Later on in the paper there was a similar table which gave the quality of the enriched gas, but not of the unenriched; so that it was difficult to compare the two tables. Further, he did not say what kind of benzol he used—whether it was 50 or 90 per cent.

Mr. Stephenson: It is 90 per cent.

Mr. Livesey said when it was worked out, 0·072 gallon per 1000 cubic feet of mixed gas gave 13,888 cubic feet per gallon; but when it was remembered that in this 13,888 feet he had 1300 feet of blue water gas, which must be enriched to fully 15¼ candles, it showed that if he enriched that alone it gave him 22,875 cubic feet of blue gas only raised one candle. He (Mr. Livesey) should like to know whether the coal gas in this case helped, or whether the benzol had also to help, to enrich the coal gas. There was no statement as to the illuminating power of the coal gas itself.

Mr. Stephenson said he mentioned on the previous day that it was 14·7 candles.

Mr. Livesey said they had in that case 1500 cubic feet of blue water gas which had to be enriched to 15¼ candles, and 12,000 cubic feet of coal gas which had to be enriched half-a-candle, from a gallon of benzol. It seemed to him that this was a very high enrichment for benzol, and that the point required a little more elucidation. Notwithstanding this, to his mind it was a result that might be very useful indeed to some of those whose works were not large enough to put down a complete water-gas plant, but who would be glad to adopt the system. If they could produce anything like the result the author had shown, there was something to look forward to; and they might still be able to defy the electric light, or any other illuminant.

Mr. A. Allan (Scarborough) said he noticed that the author of the paper, before he adopted the Lewes system, worked with ordinary hydraulic mains; but that when he decided to introduce this system, he also determined to make a most important change in his usual routine, by discarding the hydraulic mains and working with dry mains. He should like to ask Mr. Stephenson what his make of gas per ton was when working with the hydraulic, because he thought a very great deal of the extra production per ton was due to the dry mains. From his own experience, he found an increase of from 700 to 1200 cubic feet per ton when working with a dry main compared with the hydraulic. He had an excellent opportunity of noting exactly what the difference was, as in his retort-house both systems were worked separately. Using exactly the same coals, he found that when changing over from the dry to the hydraulic main the make fell considerably; but the moment he changed back to the dry main it went up again. The make of gas per ton at Scarborough for the six months ending the 31st of December last was 12,067 cubic feet with dry mains; and this was obtained when working at a level gauge in the retort-house, or, if anything, a slight back-pressure. He observed that Mr. Stephenson worked with 1-10th vacuum on his retorts; and he obtained 12,081 cubic feet of gas per ton. He had no hesitation in saying that, if he were to work with this vacuum, he could obtain as large a make per ton, or even a larger one. Therefore he thought the higher make as compared with the previous working was due to the dry mains. Mr. Stephenson partly attributed the increase to the tarry vapours being converted into illuminating gas; but this would also tend to decrease the production of tar. Perhaps, in his reply, he would state if it was so. From the description given of the coals, he should say they were somewhat similar in quality to those he used at Scarborough; and he saw no reason why he should not have a corresponding make of gas from dry mains. But whatever benefit he might obtain from a lower pressure, he did not think the author was altogether justified in taking credit for the increase in his make of coal gas per ton from the adoption of the process described in the paper.

Mr. C. E. Botley (Hastings) remarked that when Professor Lewes, a few years ago, threw out the idea of using blue water gas to add to the volume of coal gas to take up any hydrocarbons that were possibly carried forward, it was at a time when the price of coal was growing to a very enormous extent; and he looked upon it as a sort of saviour. Knowing Professor Lewes so well, he need hardly say they went into the matter *con amore;* and no effort was spared to make the trial a success. Practically, it was on similar lines to those described in the paper. They brought a 6-inch main from the carburetted water-gas plant, and from the main took a connection which went through one of the covers on the arch-pipe, and so into the retort. The results being rather disappointing, they made some changes in the arrangements, but with no better success. They undoubtedly had an increased volume of gas; but it was obtained at the cost of the illuminating power. He therefore regretted to say they had received no benefit. They used only Durham coal, and exhausted very well; getting about 10,300 cubic feet per ton of an illuminating power of 14¼ candles. Of course, the quality of the tar was not very high; and he was inclined to believe that their utter failure to secure good results was owing to the quality of the coal. If Mr. Stephenson had the opportunity of using Yorkshire coal, he believed there was a certain amount to be made in that way; but with Durham coal, as he had said, there was no benefit whatever.

Mr. A. G. Glasgow, being called upon by the President, said his sole qualification to discuss the paper before the meeting was because he had been invited to do so by the Council. He did not wish the members to think he had anything interesting or useful to lay before them. On the contrary, he was somewhat embarrassed to manufacture any discussable arguments from the material put forward in the paper. The author presented merely the somewhat incomplete results of his working, while passing blue water gas through his coal-gas retorts. He did not hear the paper read, and there might be some remarks interpolated, of which he was not aware; but, so far as he knew, the author made no comparison whatever with his working under normal conditions, and he gave no facts by which they could test the accuracy of his conclusions. Mr. Stephenson would pardon him for saying that recent experience of some of his arithmetical processes had not encouraged him to swallow wholesale, and with unquestionable faith, such results as he had laid before the meeting. To be specific, what he required to know, and what it was necessary to know, in order to reach any definite issue in discussing this system, was a complete analysis of the candle power of the blue water gas; also a complete analysis of the calorific and candle power, and the make per ton of the unenriched coal gas distilled separately—and, it was needless to say, under precisely the same conditions as it was now distilled. They

also required a complete analysis, with the candle power and make per ton, of the mixed gases, not only when the blue water gas passed through the retort, but when it was conducted out of the retort—anywhere before condensation; and also, when that gas was mixed, after the two gases had been completely purified, and likewise the full photometric record. All this matter must be multiplied sufficiently to eliminate any periodical fluctuations. In other words, they must have a true average. With such data before them, they could follow what took place in the retort when the blue gas passed through, and accurately compare the distillation with and without the blue gas. They would see, therefore, that there was so much information omitted, and so little given that was essential to an intelligent discussion of this question, that such a discussion was rather burdensome. He (Mr. Glasgow) was labouring under the disadvantage that the little thunder he had been able to manufacture had been stolen by Mr. Broadberry. He might say further that in Mr. Stephenson's other writings he thought he gave the make of his gas, prior to the use of water gas, as nearly 11,000 cubic feet per ton; and he also stated that, of course, he used the dry main, referring to the blue-gas retorts, without which he could not get anything like such results. The paper showed that this change from the hydraulic to the dry main involved not only its usual consequence (which had been referred to by Mr. Allan), but in this case, if he was correct, a change from a back-pressure sometimes of 3 inches to a constant vacuum of about 1-10th. These statements gave him some small peg on which to hang a comment or two. He might add that, in addition to this change, Mr. Stephenson described the very great care he found it necessary to exercise in his carbonizing work. He also stated that he was using very good coal, and fresh; for in one place he referred to a relapse in the result when he employed coal taken from stock. Therefore he (Mr. Glasgow) must say that he was of the opinion of Mr. Broadberry and Mr. Allan—that Mr. Stephenson might very well look to these simple changes in his carbonizing operations for the increase with which he had credited himself as due to passing the blue water gas through the coal-gas retort. There were not sufficient facts to enable one to speak definitely. But the author had perhaps made an error in attempting to explain how he got the increased result, owing to the change in the process of distillation; and in order to deal with this, he would refer to the portion of his paper where he gave the figures for the months of March and April. It appeared that the water gas added was 9¾ per cent. of the total.

Mr. STEPHENSON: It was 12·92 per cent.

Mr. GLASGOW said he was referring to the percentage of the total, not the percentage of the coal gas; and he thought it would be found that it was less than 10 per cent.

Mr. STEPHENSON said 12·92 per cent. was added to 100 of coal gas; it was not the quantity in the gas.

Mr. GLASGOW said he would accept the figure given; but what he had been thinking of was the water gas added as a percentage to the coal gas. He was taking the proportion of the total, which was something like 10 or 11 per cent. There was a gain of 10 per cent. in the volume of coal gas; so that the water gas took up and carried away its own bulk of elements which otherwise the coal gas would not get at all. What were these elements? Mr. Stephenson attributed them to two causes—the first being the prevention of the decomposition of the hydrocarbons. He (Mr. Glasgow) was only a mere smatterer as an organic chemist, but he had never known of any hydrocarbons present in gas or tarry vapours that did not increase their volume by decomposition; and if he prevented the decomposition of these vapours, he kept them in the form of vapour, instead of allowing them to expand into the greater bulk of a permanent gas. Then, secondly, the reason given was that a portion of the tarry vapours were permanently converted into illuminating gas. This reasoning was blowing hot and cold. It prevented the tarry vapours from being decomposed and rendered permanent, and it also made them permanent by decomposition. Certainly, it was in neither case an intelligent reason, because the decomposition of hydrocarbons must make for bulk; and it was only the bulk they had to explain. In the other case, they could not make tarry vapours permanent by hustling them out of the place where they might possibly be brought into such a condition. The author had apparently fallen into the same mistake that many people made. It was one thing to make a statement, and a very different thing to explain it; and he thought Mr. Stephenson would have done much better to have left that alone. To take another view of this extra 10 per cent., which was of the nature of tarry vapours or heavy hydrocarbons, by Professor Lewes's analysis the total illuminants in coal gas were 4 per cent.; and if they added to this about 10 per cent. of something which must be very similar—because it was the tarry vapours that he was conserving, and preventing being decomposed—he would get 2½ times as much in the main alone, and in the coal gas he would get 30-candle power. To take another view, the 10 per cent. was undecomposed tarry vapours made permanent by some mysterious process. Had the tar gone? Did it contain volatile vapours? How much pitch was there in the tar? He feared there was not sufficient reference to the good old law of the conservation of energy throughout this paper, because the result seemed to be that the author appeared to get something out of nothing. He (Mr. Glasgow) had never yet had occasion to express his views with regard to the so-called Lewes process; but he might say that if the Professor had known the state of the law, he would have hesitated to take out so broad a patent as he had recently obtained in connection with the process. Going back practically as far as 1820, there were more or less indications which might be held to anticipate his claim. At least, there was, in 1851, a most specific one, granted to Mr. Gore, for the passing of blue water gas through coal-gas retorts during distillation. There was an action in America which caused considerable interest at the time; and he thought it would be found that not only blue water gas had been tried, but hydrogen gas, and even air and steam, and steam with small sprays of petroleum vapour. There were also multiplied forms suggested for taking the gas from the coal-gas retort, and getting it away more quickly than it was made. This was nothing but a question of the difference of pressure, which created a flow. They could back up the pressure behind, or relieve it in front, and the gas would go just the same; but it would not go any faster than it was made. Coming to more recent matters, there was a highly interesting communication from Mr. William Young on the Peebles process, in a recent issue of the "JOURNAL OF GAS LIGHTING."* It was an article by no means in his (Mr. Glasgow's) favour, as the promoter of the Lowe process, but it was one of the most interesting, able, and carefully thought-out presentations of this subject he had ever read; and when he found the immense amount of pure nonsense that had been written and talked about, he thought he could not do better than advise himself to read it again, as he should certainly advise Mr. Stephenson and others to read it. It was not only a very interesting article, but it referred to a patent which its author and some collaborator took out in 1875, most completely covering the question of admitting blue gas to the retorts—in fact, treating it as common knowledge of the time—and covering an improved way of doing it by regulating the amount to the exact quantity of coal gas that was being evolved. It also covered the admission of the blue gas at other parts of the plant before condensation—viz., in the presence of the tarry vapours. He might add that he was perfectly satisfied, from his experience, that there was some enrichment to be got by admitting the blue gas to the coal-gas retorts, but not a particle more than by admitting it to the hydraulic main, or to any point where it was in the presence of the undecomposed tarry vapours. In other words, taking benzol, for instance, to which coal gas owed much of its luminosity, that was a pure vapour. It was not a gas at all; and blue water gas contained no benzol, and no vapours which were solvents of it. If they opposed water gas, with no such vapours in it, to an atmosphere containing them, it would saturate itself, so far as those vapours went; and in this way water gas would secure a certain amount of enrichment. As to the benzol, however, so far as he was able to gather, about 95 per cent. of all that was produced remained in the coal gas, and 5 per cent. was carried down in the retort; so that there was no large amount available for the saturation of the water gas, and only a small quantity of water gas could be profitably dealt with in this way. Again, one might ask whether the enrichment, even to this small extent, was of any use. It was a question whether, if they introduced 10 per cent. into the coal gas as it was manufactured (say at the outlet from

* See "JOURNAL" for the 5th ult. (p. 285).

the station meters), this small proportion would not be as useful in preventing condensation of the vapours in the coal gas on the way to the consumer as if they allowed it to pass into the retort, and gave it the partial burden of evaporation in advance which would prevent it carrying that which would otherwise condense in the mains. The whole question of enrichment depended upon what reached the consumer.

Mr. A. F. Browne (Vauxhall) said the paper was an extremely interesting and important one—so important, in fact, that it was highly necessary to criticize it as freely as possible. He proposed to deal with it from the chemical and physical points of view; leaving the financial and commercial points to others. They had at the opening of the paper a plain statement of what Professor Lewes contemplated in passing blue water gas through the coal-gas retort. It appeared to him the Professor intended that the blue gas should take up certain illuminants that were now condensed in the tar, and assist in carrying through the heavier hydrocarbons, and, above all, that it should prevent the dissociation of gases in the retort. It appeared to him there was no doubt whatever that these results had been secured at Tipton. It was only necessary to compare what went before the addition of the blue water gas with what followed, after to see that. When Mr. Stephenson worked for two or three days without the addition of the gas he immediately had enormous dissociation of gases and all the consequent troubles. He applied the blue water gas, and since then had suffered in a very small degree from these nuisances. He (Mr. Browne) should like, however, to ask one question on which his argument would turn. He assumed that the blue water gas as produced was passed into a special holder, where it came down to something like atmospheric temperature, and was measured through the rotary meter into the retorts. If this were so, the retort would be, in some measure, cooled by the influence of this stream of gas passing through it. He could not at all see, therefore, how the make of gas per ton of coal was to be increased by anything more than the small volume (say) of benzol, or perhaps other hydrocarbons, which would exist as vapour, and not as gas. They all knew that when a charge of coal was placed in a retort, the surface temperature came down with great rapidity; but if Professor Lewes's views were correctly represented, it was just at this time that he considered it most important that this addition of water gas should be made, doubtless for the purpose of carrying vapours in diffusion which would ordinarily be condensed. Passing on to the question of the abolition of the seal and the substitution of the dry main, they had the statement that Mr. Stephenson had found very great advantage from it elsewhere; and this had been confirmed by other speakers. It was not, however, the experience of the Engineers of the South Metropolitan Gas Company. They were in favour of the hydraulic seal; and he thought there was one station in which the seal had been substituted for the dry main, and the make of gas, instead of decreasing, had shown an opposite tendency. Mr. Stephenson in the course of his paper said he was obliged to work with a slight vacuum in the retorts, because, if he did not, the hydrogen in the water gas would be likely to leak out. This statement had been met by Mr. Glasgow. He could not accept the statement, if Mr. Stephenson's retorts were reasonably tight, that he would be unable to work them at a slight pressure, because he would lose so much water gas by the diffusion of hydrogen through them. If they were tight enough to hold coal gas, they were equally so to hold water gas. The next point was the alleged increase in the make per ton of coal; and he agreed with previous speakers in believing that it was not—except possibly to a very small extent—due to the introduction of blue water gas into the coal-gas retorts. Mr. Glasgow had dealt with a point he had intended to bring forward, but which he might amplify somewhat. It was, he believed, a fact that if a gas such as ethylene, or marsh gas, was dissociated in the retort, the carbon was converted into graphite, but the original volume of gas was doubled. However, as results at Tipton showed, this process of dissociation was largely, if not entirely, done away with; and therefore they would expect the volume of coal gas per ton to be decreased rather than increased. The cool gas entering the retort would surely have a tendency to reduce the temperature; and he saw no reason why the make of gas per ton should be increased, except by the mechanical means already pointed out—that Mr. Stephenson was working not only with a small vacuum in his dry main, but actually with a vacuum of 1-10th in his retort. He (Mr. Browne) would be very sorry to do this, for even two hours, in any works for which he was responsible, as he was afraid the consequences would be somewhat serious. At the same time, he did not wish to disparage Mr. Stephenson's work. It appeared to him that, in the result, he obtained gas of good illuminating and calorific power; and therefore he deserved well of his Committee and the consumers. What he (the speaker) was anxious to argue out was this—that Mr. Stephenson did not get the increased volume from the process. Whence did he get it? He got it from the coals—from the mechanical effect of working the retorts at a vacuum. There was only one other idea that had crossed his mind which seemed a possible explanation of the increase in volume. He should like to ask Professor Lewes if it were at all possible that the increase was derived from the water gas, not from its enrichment with, or its holding in suspension, certain vapours, but from its being brought into contact with the incandescent coke in the retorts. Was it possible that the large percentage of carbonic acid in the water gas could be reduced in passing through the retort by contact with the hot coke, or with the dissociated gases and the carbon dioxide converted into carbon monoxide. He believed he was right in saying that, if this were the case, there would be double the volume. One volume of carbon dioxide reduced to carbon monoxide became two volumes. If this were so, there would be at once an increase in the make, not of coal gas, but of water gas.

Mr. J. P. Leather (Burnley) said he had read through the paper very carefully, and had worked out a number of calculations which led him to make certain criticisms, in which he had been forestalled; and therefore he would not think of repeating them in their fulness, as Mr. Glasgow had very thoroughly dealt with so many points. There were, however, just one or two things which did not thoroughly come out in his remarks, and to these he would refer. Two very important figures were added to the paper by the author—one was that his coal gas had an illuminating power of 14·7 candles apart from the process. Now, taking the table given by the author, and calculating the effect of adding the percentage of blue water gas there stated to the 14·7-candle coal gas, they got as a result, simply by an ordinary proportion sum, 10·6 candles. This did not necessarily prove that by mixing water gas having no illuminating power with coal gas of 14·7-candle power one would only get 10·6 candles. Perhaps even mixing them cold, it might be possible to get this on the photometer. Mr. Stephenson obtained 11·13 candles, or half-a-candle better. They had heard from Mr. Grafton that, practically speaking, a quarter-of-a-candle difference in illuminating power was as near as anybody could get, and very frequently half-a-candle; so that this process did not seem to show any gain in the light-giving power from mixing water gas with coal gas, even after purification. Then they were reduced to the question of quantity; and with regard to this he did not think that any of the speakers had taken notice of the fact that the author gave another figure in parentheses—viz., that when for a short time he stopped the process, and went back to simple coal distillation, he found a drop of 600 cubic feet per ton for the few days he tried it. This seemed a more important figure than almost any in the paper. There was actually, under apparently similar conditions, a difference of 600 cubic feet per ton when working and when not working the process. The calculations he had made had been much on the lines of the remarks of Mr. Glasgow. Where did the 600 cubic feet come from? He would not repeat the criticisms Mr. Glasgow had passed except so far as this—that if they assumed, for example, that it was benzene vapour that gave the 600 cubic feet (this being one of the lightest vapours in the tar), it would require about 123 lbs. of benzene per ton of coal to give these 600 feet—almost as much benzene as there was tar altogether from every ton of coal. Whichever way the matter was looked at, there did not seem to be any means of accounting for the 600 cubic feet. Then, of course, came the query: Were these figures right? If they were right, there was no question of saying whether or not it was according to theory. If they were right, and theory did not agree with them, they would have to alter their theory. He did not say they were right; but he thought Mr. Glasgow's questions, in the early part of his

remarks, were very much to the point. They wanted more information, particularly as to the effect on the tar, and other matters. Still, if there was really a gain in the make, they must find a theory to account for it. Professor Lewes had been asked whether he had a theory about it; and perhaps he would say something. It occurred to him (Mr. Leather) that there might be some possible way in which the water gas in the retort might have an influence on the quantity, by some means that they were at first, perhaps, not inclined to recognize, because they did not know exactly what was the constitution of the gas in the retort. They knew what its constitution was when it came out, but not what it was when passing over the coal before it came into contact with the hot upper surface of the retort. It might contain considerable quantities of acetylene; and what, he asked, would be the effect of that? They knew that acetylene readily formed benzene in the ordinary way; and it was possible that the benzene they had in the coal gas came, to a considerable extent, from the condensation of acetylene. But, of course, while acetylene might produce benzene, it might also produce many other things when heated; and it apparently was the source of the carbon which was deposited on the retorts. By passing in water gas, they might have some different effect produced on the acetylene by the fact of the hydrogen being present in considerable quantity and producing (say) marsh gas instead of benzene. If they tried to make a formula for the production of marsh gas from acetylene instead of benzene, they would have three times the volume. Of course, these were only suggestions. They must first of all be sure that the facts were right; and if they were, they would have to find a theory to explain them.

Professor Lewes said he had been listening with the keenest enjoyment and interest to the discussion which had been going on upon what had been termed the Lewes process. Some five years ago, at a meeting of the Gas Institute, he gave a lecture, in which he said he thought they had before them a great possibility of saving in the retorts certain hydrocarbons which might otherwise be destroyed, by treating them in a particular manner by blue water gas. He pointed out that this work was in no way novel, as White had tried to do it in 1850, and others even before that date; and that hundreds of observers had attempted to do it since, and had failed for certain definite reasons. If he were asked at the present moment what he thought of his own process, he could only say that he had not the vaguest idea. He had not, because he did not think what might be truly termed the Lewes process had really been tried. If they took a retort and carbonized coal in it, and then passed a stream of cold water gas through it, as had been pointed out already, they had a checking of the heat, and possibly a different set of distillation processes going on than those which could be carried on at high temperatures. They would find, moreover, that in these distillation processes they had matters of such utter complexity, that it certainly was no trouble to be asked to explain anything that happened. One gentleman apparently wanted to know where the increase in volume came from. They simply had to say it arose because more of the hydrocarbons were broken up, and gave off a larger volume of hydrogen. Another put the question in a different way, and wanted to know how one could explain the fact that there was not an increase in the volume. It could be explained in a moment. The water gas, by virtue of its presence, prevented the transformation of some of the hydrocarbons into naphthalene. There was not the slightest difficulty in dealing with the matter. A point was raised by Mr. Glasgow with which he thoroughly agreed—that they had not really got the figures to argue upon at the present time. He most heartily thanked Mr. Stephenson for having put before the meeting a clear and honest statement of facts of work done in his own way, which he thought all the members of the Institution would realize was what they desired to get at. The production of papers of this character really gave the factors on which they could afterwards come to a basis of conclusions. But to say at that time that they had two rivals in the market—this possible Lewes process on the one hand, and the carburetted water-gas process on the other—was simply nonsense. They had had ten years of figures in regard to carburetted water gas and what it could do, and they knew all about it. They knew nothing whatever about this new process. It might be a thoroughly bad one. Mr. Botley said it was; and if he said so, it must be so. What he (Professor Lewes) hoped for, was that all experiments that were made should be put on record, because they were so absolutely on the fringe of the matter. Though they had been using coal gas for a hundred years, their ignorance was enormous on the subject of what was going on in the retort; and it was really experience, and the jotting down of facts that were noticed, which was required. This was what he hoped they would get in the near future. He must pay a tribute to Mr. Glasgow. It was always a pleasure to hear him speak; and that morning they must all admit he was in his most brilliant vein. He (Professor Lewes) must say that if all gentlemen who had processes, and were interested in processes, would defend their rights and evoke discussions of the same piquant character as Mr. Glasgow did, they would be only too delighted to see as much of them as possible. He once more thanked Mr. Stephenson for his paper, and hoped that others of like character would be multiplied, because it was just the sort of communication they wanted. Mr. Browne had asked him a definite question, which he would endeavour to answer. He put forward the suggestion that, as they passed water gas through the retort, it might be possible, or probable, that the carbon dioxide present in the original water gas would get reduced by the red-hot carbon in the retorts, and cause an augmentation in volume, because of the increase in the carbon monoxide that was produced. Of course, wherever they had one volume of carbon dioxide reduced to monoxide, they had double the volume. His idea was that they would get this action—that they could use crude water gas for passing through the retort, and that then the further reduction by the red-hot carbon in the retort itself would entirely bring it down to carbon monoxide again, and so they would get away from all question of purification. But he never had been able to obtain any justification for putting this forward. He had not found that where they had put water gas containing a certain proportion of carbon dioxide through the retort, they had any large reduction in it in the retort itself. These actions—and, indeed, the idea of the process was entirely dependent on that—were to an enormous extent retarded by dilution. Where they had a small percentage of carbon dioxide diluted by a large volume of other gases—hydrocarbons, hydrogen, and so forth—the action of the carbon upon it was much slower than where they had pure carbon dioxide. If they put pure carbon dioxide through the retort, they would find a very big reduction, and conversion into carbon monoxide taking place; but, so far as he had found out, it did not take place with the passage of water gas.

Mr. Stephenson, in reply, thanked the members for the very great attention they had given to his paper, and for the interesting discussion upon it. He thought at one time of dropping the paper, for certain reasons; but he was very glad he did not. He was pressed to give it because it was a new thing. He naturally had had very little experience of it as yet—really only three months; and consequently he was not possessed of that fund of information on various points which had been asked for. It was suggested that he knew practically nothing about the thing; and he confessed that he did not. As regarded the increase in volume, which was the most interesting part of the subject, many gentlemen had been kind enough to suggest reasons, for which he thanked them. He had expected something of the sort. Mr. Broadberry, in opening the discussion, suggested that hydrogen would not go through the retort, which was possible, and that nitrogen was present, which was very likely. But he meant to take good care that hydrogen could not go through. With regard to the suggestion of producer gas being present, he thought that if this were so the illuminating power would be very much further reduced; and if oxygen were present to any extent, it would have rather a bad effect on the oxide purifiers. Mr. Leather pointed out that he made a test of reverting to coal gas manufacture alone, without admitting any water gas. He still kept the same pull on the retort of 1-10th, and worked off on both sides; and there was a drop of 600 cubic feet per ton. There was no doubt that the increase in the make was the thing they wanted to understand; but they were very glad to have it. Mr. Broadberry said that the oily tar did not get to the consumers' meters, and that he (Mr. Stephenson) ought not to have made such a statement as he had done in the course of the paper. It so happened that his notice was called to the fact that the manager of a large company brought to his directors consumers' meters

which were smelling abominably—thus proving that oil was dropping there. Mr. Livesey suggested that the large amount of gas they were getting from the coal was caused by the conversion of the coke into water gas, and mixing it with 3 gallons of benzol. He did not follow him, because if more than a certain proportion of water gas were mixed with the coal gas, the advantages were lost. About 40 per cent. was the limit, as Professor Lewes discovered; and he would not care to go above that. Of course, with carburetted water gas, one could go a little farther. Mr. Hills made the tests given in the paper; and he (Mr. Stephenson) left the matter entirely to him. He did not give many of the figures which were asked for; but this was the record of his results. Mr. Allan and one other speaker acknowledged the benefit of the dry main; and he was glad to hear it, because he always understood that in the South of England and many other parts it was disliked, and was not considered to give good results. His experience was that a greater make was obtained. At the same time, he tested this a few days previously, working the dry main, and there was a drop in the make. With regard to the coals, he did not think Mr. Allan was quite right. The Yorkshire coals were remarkably fine rich coals; and he should much like to work them entirely. They were richer both in illuminating properties and in gas than North Staffordshire coals, which he was mostly compelled to use. As to the quantity of tar produced per ton, he made up his returns for the last three months, and expected to find that there was a diminution in the quantity; but practically there was nothing to call a diminution. Virtually, the same amount of tar was produced, so that he was still as far off as ever from discovering the reasons for the increase in volume. He certainly thought a lot of the benzol in the tar was taken off, and they might as well have the advantage of it. They could not say for certain what was the quality of the tar, as he had no appliances for testing. But they were getting a higher price than before; and so they were satisfied. Mr. Botley spoke of the advantages of water-gas plant generally in the event of the market for coal going up. He appreciated this very strongly, and was glad to have a water-gas plant for this reason alone—that it tended to control the market. If they had coal high in price and coke a drug, they could convert the coke into gas, use less coal, and have less coke to sell; and in this respect he as much admired the carburetted water-gas plant as the other. He was not at all a special advocate of the process that he had adopted; but it was very covenient, and he was glad to have tried it, and to have given the records he had up to the present. Mr. Botley thought he could not get the same results from Durham coal; and he did not think he could either. Mr. Botley also said that he had tried the Lewes process with this coal and got an increase in volume but a decrease in quality. So did he. But he also got an increased quantity by putting water gas through; and therefore he enriched too, as Mr. Leather pointed out. Taking Mr. Paterson's figures of the illuminating power of water gas, there was a slight gain shown. But he thought 11·13 candles was not the high-water mark of the tests taken. He knew Mr. Hills got some higher figures. Mr. Glasgow had alluded to the incomplete record of results, to which he had already referred. He had had but a short time for working, and could not get all the results he should like; besides, he had had troubles in between, which prevented him following up the matter to the full. Mr. Glasgow had made reference to some arithmetical mistakes, of which he was quite aware. He replied very hurriedly to a paper by Mr. Glasgow, in a letter to the "JOURNAL OF GAS LIGHTING," and had no time to run through his copy; but he saw his mistake the next day, though he did not feel inclined to follow it up any farther. He thought perhaps Mr. Glasgow might not notice it. Reference had been made to his having a relapse in the make when using coal out of stock. Most people had this experience. Coal did not improve by being stocked. As to the care he exercised over his carbonizing, since he had been at Tipton he had always been very particular in the retort-house. It was there, after all, that their profits or losses were made; and it was highly necessary that care should be taken in the make, he should imagine, by the carbon being decomposed in the retorts. The naphthalene would remain all the way from the retort-house to the meter. He could not see how the naphthalene could be dropped out of the gas without decreasing the volume. Mr. Glasgow said that they could not make tarry vapours permanent by hustling them out of the retort. He might be right; he (Mr. Stephenson) had not gone far enough into the question of tarry vapours to understand that. He merely gave his own ideas on the subject of the increase in make; and as there was no very great diminution in the quantity of the tar, he should not think there was much got out of it. He was not the only one who had tried the Lewes process recently, and had obtained increased results. A paper was a short time since read by Mr. Brockway, of Cleethorpes, at a meeting of the Eastern Counties Gas Managers' Association (*ante*, p. 218), in which he stated that, by heating up the water gas and running it into the foul main, he got an increase in the make of coal gas; so that there must be something in it. Mr. Browne considered that in his use of the Lewes process he was admitting water gas cold (it was certainly cold before it reached the holder), which would lower the temperature of the retort, and therefore the make of coal gas. But, as he pointed out, the water gas entered the ascension-pipe, came down, and entered at one end; and, as Mr. Valon showed some years ago, gases did not take much heating. He thought this was so; and he was of opinion that the water gas was heated before it had travelled very far into the retort. He also considered that if the retorts were tight enough for coal gas, they might also be tight enough for water gas. This, too, was quite probable; but he did not like to keep a wholly level gauge on the retort. They did not purify for sulphur compounds. The gas entered the oxide purifiers first, where all the sulphuretted hydrogen was taken out, and then went to the lime purifiers, making a commercially pure carbonate of lime, which he was glad to say he was able to sell. Mr. Leather said there was practically no gain in illuminating power; but there was a little. In conclusion, he could only say he was very pleased indeed to have raised so interesting a discussion.

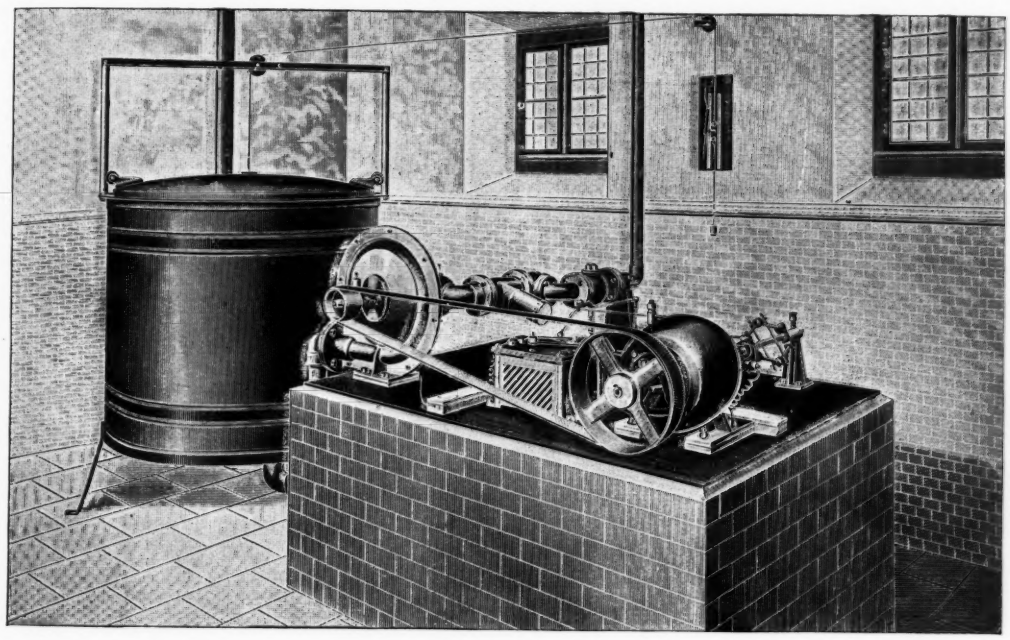
THE "SELAS" SYSTEM OF INTENSIFIED LIGHTING BY MEANS OF AN ADMIXTURE OF GAS AND AIR.

By F. D. MARSHALL, of Copenhagen.

Light! More light! is the craze of the day; and to satisfy this craze the competition between gas and electricity becomes daily more deadly, and we should be thankful to those who, by careful study and experiments, lead us into the right paths and enable us to uphold our industry. It is impossible to direct one's attention for a moment to the question of improved gas lighting without again and again offering a mental tribute of appreciation to that great Austrian, von Welsbach. What our industry owes to this man cannot be penned in ordinary words; and it will always redound to our national discredit that the benefits of this momentous discovery were practically withheld for years from our reach by unscrupulous financiers, whose doings in connection with this matter not only meted out financial ruin to many, but to an extent dragged the honoured name of von Welsbach through the dust.

The study and application of von Welsbach's discoveries offer a most fascinating field; and two very notable papers have within the last two years been presented to the gas profession—viz., that by Mr. Walter Grafton, before the Gas Institute in 1901, and, later, by Professor Vivian B. Lewes, in the course of his Cantor lectures at the Society of Arts. Both these gentlemen touched upon the great advantages to be obtained in developing luminosity from the ordinary incandescent burner by a further addition of air to the coal gas consumed in the burner. While both were perfectly correct in their theories, neither was in a position to put forward a practical and commercial solution; and, after all, commercial success is what we are ultimately aiming at. What these gentlemen pointed out seems almost a paradox—viz., that if we are to obtain the best results from the "fattened up" gas which the majority are bound to supply under the useless and obsolete regulations now obtaining, the same must be submitted to a course of banting, and be thinned down and attenuated beyond all recognition, to an almost vanishing point of luminosity, before it really becomes practically useful.

May 8, 1903, was a memorable day in the history of gas-lighting, when that great iconoclast Sir George Livesey shattered the 16-candle idol, and set up in its stead the

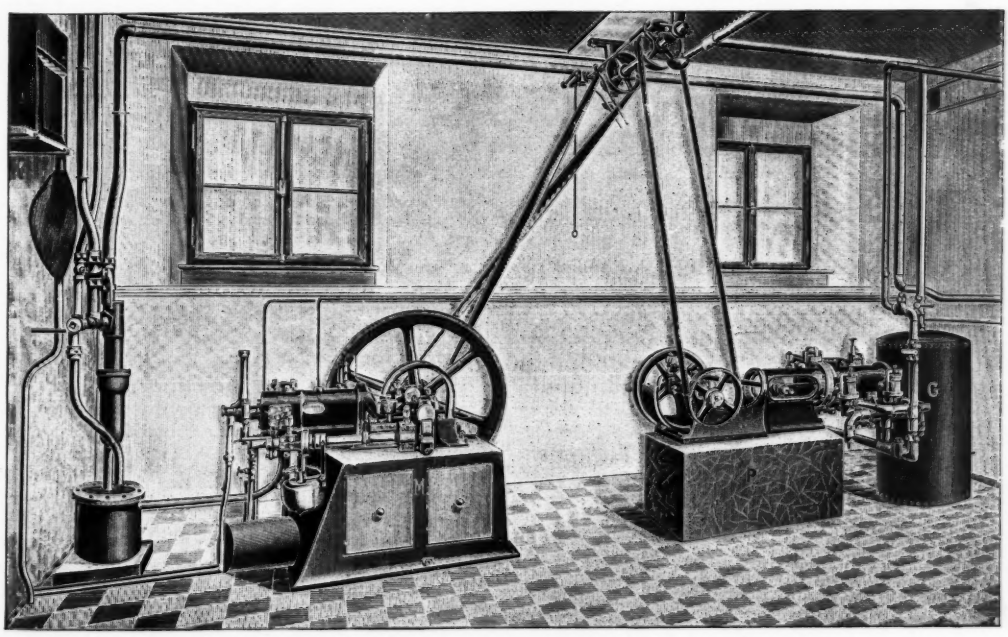


THE "SELAS" LOW-PRESSURE APPARATUS FOR 300 LIGHTS OF 100-CANDLE POWER.

(Constructed for the Military Barracks, Stockholm.)

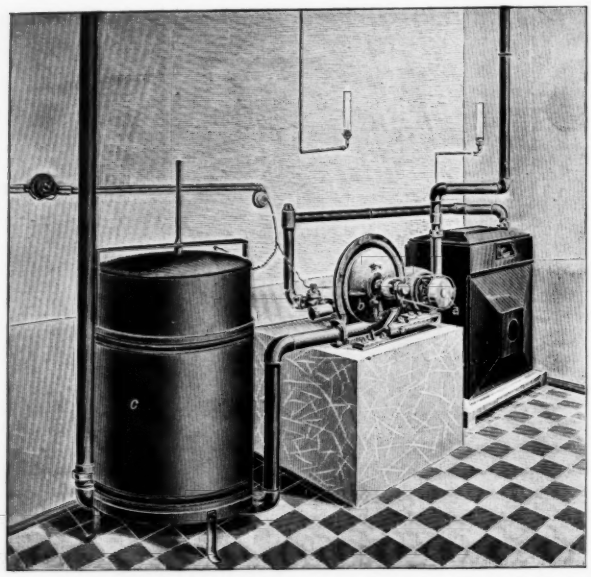
13-candle image. Some day he will shatter "this little tin god on wheels," and set up a more becoming idol in the form of a 10-candle standard; and he will offer the public no injustice by so doing—assuming, of course, that incandescent lighting in Great Britain, relieved as it now is from the fetters of the Welsbach monopoly, makes the same progress as on the Continent, which it assuredly will do. Both Dr. Bunte and Professor Lewes have shown over and over again —as, indeed, has the writer, Dr. Colman, and many others —that the difference in the calorific value of 16-candle gas (say) of 140 calories or 573 B.T.U., and of 11-candle gas of 115 calories and 460 B.T.U., has practically no influence on the light developed by the incandescent burner. Any variation in calorific intensity would be met by the air adjustment to the burner; and there appears to be no reason whatever why gas of more than 10-candle power need be supplied, provided a desirable calorific value were present. The writer believes it will not be long before the Continentals (unshackled by County Councils), having already realized this fact, will adopt a 10-candle standard. It is already on the tapis, and we appear within measurable distance of discarding the luminosity of coal gas as a measure of its goodness, and are paving the way for the sway of the calorimeter.

One of the diluents or "attenuators" which naturally presents itself to thin down our over-fattened gas is water gas. Both Mr. Grafton and Professor Lewes demonstrated what could be done in developing light from incandescent burners by the use of a mixture of coal gas and water gas of less than 5-candle illuminating power; and yet water gas, an ideal attenuator, has hitherto been employed for the "fattening up" process. Another paradox! However cheaply made, water gas, of course, costs money; and if we are bent on diluting and thinning down, we have a medium

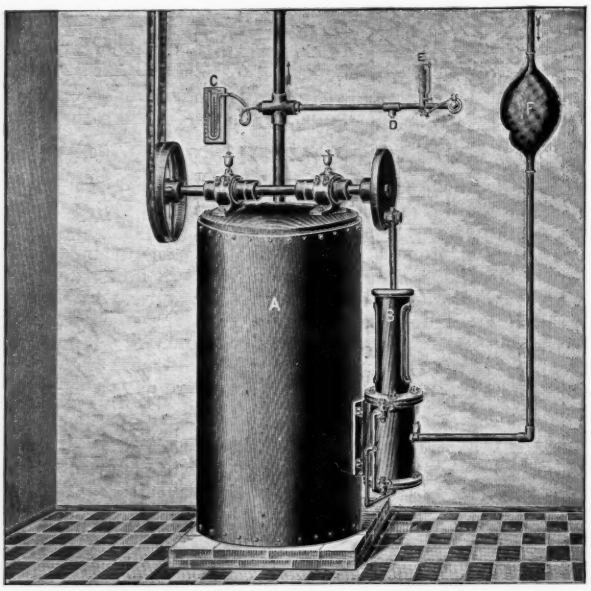


THE "SELAS" HIGH-PRESSURE APPARATUS FOR 60 LIGHTS OF 1000-CANDLE POWER.

(Fixed at the Dyeing and Calendering Works of Georg Schleber, Ltd., Greiz, Germany.)



THE "SELAS" LOW-PRESSURE APPARATUS FOR 100 LIGHTS OF 100-CANDLE POWER, DRIVEN BY ELECTRIC CURRENT.



THE "SELAS" HIGH-PRESSURE SYSTEM FOR 10 LIGHTS OF 1000-CANDLE POWER.

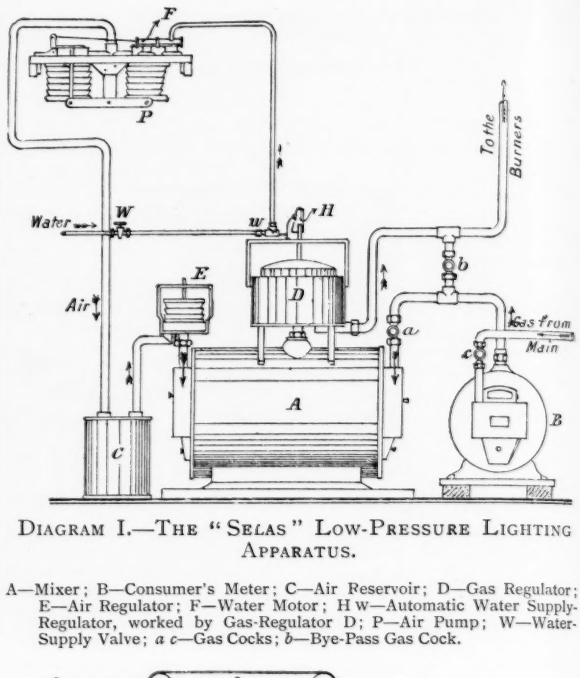


DIAGRAM I.—THE "SELAS" LOW-PRESSURE LIGHTING APPARATUS.

A—Mixer; B—Consumer's Meter; C—Air Reservoir; D—Gas Regulator; E—Air Regulator; F—Water Motor; H w—Automatic Water Supply-Regulator, worked by Gas-Regulator D; P—Air Pump; W—Water-Supply Valve; *a c*—Gas Cocks; *b*—Bye-Pass Gas Cock.

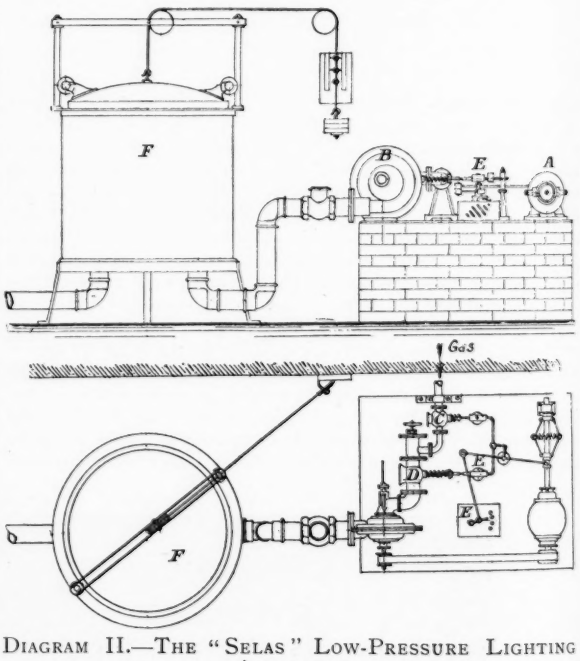


DIAGRAM II.—THE "SELAS" LOW-PRESSURE LIGHTING APPARATUS.

A—Electric-Motor; B—Turbine Mixer; C—Gas-Supply Valve; D—Air-Supply Valve; E—Speed Regulators; F—Gasholder.

at hand in the form of air, which costs nothing, and which may be employed with extraordinarily successful results.

The idea is by no means new. The late Mr. Frank Livesey showed conclusively the effects obtainable by mixing air and gas at some distance from the incandescent burner, in contradistinction to mixing in the burner itself; while, later, in Mr. Grafton's paper, the tabulated statements (Series A) show some remarkable results. Diluting very poor 13·2-candle gas still more by the addition of air until it was only 10·9 candles, the diluted mixture gave with gradually increased pressures from 1 inch up to 3 inches, 76 candles as against 58, 81 as against 60, 86 as against 56; and by raising the pressure to 3 inches, Mr. Grafton obtained 93 candles per 6 feet of "mixture" consumed, as against 56 candles per 6·74 feet of unadulturated but low-grade gas.

It is apparent that not only the addition of air but pressure plays a very important part in procuring these enhanced results. The ultimate effective results obtained in an incandescent burner must naturally depend on the calorific value of the gas used, as the mere addition of air cannot alter this as has sometimes been supposed. But what the addition of air, *plus* pressure, really does, is to develop flame intensity. Hitherto the development of flame intensity has been attained (*a*) by the various improvements in the incandescent burners such as the Kern, Bandsept, Denayrouze, Keith, Sugg, &c., &c., principally by enlarging the mixing chamber or stalk of the burner, and (*b*) by raising both the pressure and volume of the gas consumed; and the results have been excellent.

The object of this paper is to demonstrate that the results of the so-called high-pressure systems, where the mixing of air and gas takes place in the burner itself, can be reached and surpassed by a low-pressure system, where the gas and air are mixed or intermingled beforehand. Professor Lewes, in the course of his Cantor lectures, referred to the plan, and expressed a wish that the writer, who communicated to him all his data, would perhaps read a paper on the subject before this meeting. Busy and clever brains have been working at the so-called "Selas" system for over six years

past, at the expenditure of much time, energy, and capital; and the failures were many and discouraging before the existing apparatus reached its present state of perfection as an apparatus scientifically and commercially successful.

Low-Pressure Apparatus.

The low-pressure apparatus is constructed on the principle of ensuring a constant and certain mixture of two volumes of air to one volume of gas burnt under a pressure of 2 to 2½ inches, and by incandescent burners consuming 1½, 2½, and 3 feet of gas, or three times these quantities of mixture; the apparatus being, besides a mixer, a pressure-raiser in a minor degree. The apparatus is made in two forms (*a*) that in which the mixing is done in a chamber by two drums working on one spindle (similar in construction to an ordinary wet meter), one drum, the air drum, being just double the size of the other or gas drum. The drums are made to revolve, not by gas pressure, but by the pressure of the air supplied to the air-drum by alternating acting bellows actuated by a small water-motor fed by a small stream from the household service; the water required to actuate the motor being inappreciable, or the water-motor can be replaced by an electric motor. In fact, in the majority of installations both are fixed—the one acting as reserve to the other.

The apparatus referred to in the Diagram I. consists of the following parts: A, mixer; B, consumer's meter; C, air reservoir; D, mixer regulator; E, air supply regulator; F, water-motor; H.W, automatic water supply regulator actuated by mixer regulator; P, air-pump; W, water supply tap; *a c*, gas cocks; *b*, bye-pass cock. The apparatus is fixed after the consumer's meter working as follows: On the gas and water being turned on, the air pumped through the bellows causes the drums to revolve, drawing in air and gas in the proportion of two to one. When the desired pressure—about 2 to 2½ inches—is raised in the drum-chamber, the bell of the regulator rises automatically, closing the water valve *w*, and the air-pump immediately ceases, to start again immediately the regulator bell descends; thus releasing the pressure on the arm and little wheel which closes the water valve.

With the apparatus working to its full capacity, the air bellows work continuously, but very slowly; whereas when the apparatus is only working with one or two lights, the bellows act only intermittently, perhaps once in one or two minutes. The pressure required is obtained by weighting the bell of regulator D. The apparatus, once started, is perfectly automatic in action, and needs no attention beyond a visit once a month to lubricate the little water-motor.

The (*b*) description of apparatus (Diagram II.) differs from the former, inasmuch as the driving power is electricity; the mixing being done by a turbine or blower. It is a beautifully constructed apparatus, both on account of its simplicity and effectiveness; the mechanical details being almost perfect. It may be described as follows: A, electro-motor; B, turbine mixer; C, gas-supply valve; D, air supply valve; E E, speed regulators; and F, gasholder. The electric stream being switched on, the mixing takes place in the turbine; the exact quantities of air and gas being admitted through the respective valves. When the small holder is full of the mixture, an electric contact stops the motor, which starts again automatically as the holder sinks. The desired pressure is obtained by weighting the holder.

There is still another form of low-pressure apparatus, in which the gas and air in separate streams is pumped by a small water-motor to two gas-bags under pressure; the gas-bag receiving the air being double the size of that receiving the gas. The mixing is done at the outlet of the bags. The apparatus is working well at the Hotel "Kalkovn," Berlin.

High-Pressure Apparatus.

This differs from the low-pressure machines, inasmuch as greater power (preferably a gas-engine) is required to drive the combined mixer and compressor. This power, however, is very low; a 1-horse power gas-engine only being required for 80 lights of 1000 candles each. The mixing and compressing machine draws in and intermingles 1 volume of air to 1 volume gas, compressing the same to 30 inches of water pressure. This is effected by two self-acting valves—the one fed by air opening double the number of times per revolution of the machine compared to that taking in the gas. The mixture is passed into a pressure-receiver for distribution; the gas-engine being started and stopped quite automatically. The apparatus is perfectly reliable in action, and requires no more attention than an ordinary gas-engine. The power to drive the mixer and compressor can, instead of using a gas-engine, be taken from any convenient source. The apparatus is shown on the diagrams.

"Selas" Burners.

"Selas" gas may be consumed in any ordinary Auer burner by simply riming out the gas jet and closing the air supply. But bearing in mind the peculiar influence an admixture of air has in diminishing the size of a flame, the best results are obtained by consuming the "Selas" mixture in a specially-constructed burner fitted with a mantle of very small dimensions. The high-pressure "Selas" mixture may be consumed to advantage in any of the high-power burners on the market by closing the air supply; but the best results are obtainable only by using the burner specially constructed for it.

Results Obtainable—Ordinary Gas.

We now come to the most interesting portion of the question—namely, the consideration of the illuminating and economical results obtainable by the "Selas" system. The low-pressure plan will be first dealt with, and attention is drawn to certain definite and tabulated results arrived at by the writer and his assistants—not that this is a special case, by any means—on Jan. 13, 1903, at Copenhagen.

Experiment No. I.—Tests made with ordinary gas (14 candle power) with ordinary "C" Auer burner.

1 inch pressure	3·9	cubic ft. per hour	= 59 candles	= 15	candles per foot.
1 "	4·0	" "	= 72 "	= 18	" "
1½ "	4·7	" "	= 103 "	= 22·3	" "

The same burner regulated to consume exactly 3·5 cubic feet per hour at 1-inch pressure:

3·5	cubic feet	per hour	= 57 candles.
3·5	"	"	= 83 "
3·5	"	"	= 70 "
3·5	"	"	= 64 "
3·5	"	"	= 58 "
3·5	"	"	= 47 "
3·5	"	"	= 85 "
3·5	"	"	= 67 "
3·5	"	"	= 63 "
3·5	"	"	= 55 "
Average			64·9

Equals 18·5 candles per foot.

Four different burners, and four different mantles, but of same kind and quality were taking:

1½ inch pressure	5·05	cubic feet	per hour	=	95·5 candles.
1½ " "	4 60	"	"	=	114·7 "
1½ " "	4·70	"	"	=	110·5 "
1½ " "	4·70	"	"	=	98·6 "
Average					106·2

Equals 22·3 candles per foot.

It must be remarked that the variations in the lighting power emitted by the "C" burner and mantle are extraordinary. But this only bears out what has been the writer's experience, and, as he believes, the experience of many others; and it all points to the unfitness of the ordinary Auer burner for emitting a regular flame temperature—the balance of the heating power of the inner zone being continually disturbed by the whirling motion of the air and gas induced by the constricted form of the mixing chamber of the burner. At one moment a very bright spot is presented by the mantle to the photometric disc, and the next instant, due to the whirling motion, a dark one. Still, taking the averages of the experiments, we may place the illuminating value of the Auer "C" burner with a 14-candle gas, at 20·4 candles per foot—a very high result, due principally to exceptionally good mantles.

Results Obtainable—"Selas" Gas.

Using the previous gas through a "Selas" apparatus, whereby the aërating took place in the proportion of 2 of air to 1 of gas, all luminosity of the flame proper naturally disappeared. The photometrical results developed by a "Selas" special burner, consuming per hour under a pressure at the point of ignition of 2¼ inches were as follows:—

			Per Hour.			Candles.	Candles per Foot.
4·25	cubic feet	mixture	= 1·41	cubic ft.	of gas	= 57	= 40·4
8·9	"	"	= 2·9	"	"	= 89	= 30·7
10·7	"	"	= 3·5	"	"	= 127·5	= 36·4
13·1	"	"	= 4·3	"	"	= 149	= 34·6
Average 9·26			3·08			105·18	= 34·1

Or, taking as a comparison the ordinary "C" Auer burner at 3·5 cubic feet of gas per hour at 20 candles per foot, or a total illuminating power 70 candles, the Selas flame, with a consumption of 3·5 cubic feet of gas per hour, gave 127·5 candles, or 36·4 candles per foot. The burner in this case normally consumed 4·25 cubic feet of the mixture per hour, or 1·41 cubic feet of gas, and gave over 40 candles per cubic foot. To pass the greater quantities, the burner was rimed out, with the result that a falling off in illuminating power took place, principally due to the fact that the mantle did not fit the flame or *vice versâ*. Experiments made at Flensburg by the Engineer of the Flensburg works of the Danish Gas Company with another "Selas" apparatus, and ordinary gas with an illuminating power of nearly 16 candles, gave the following results :—

Experiment No. 1—An ordinary "C" Auer burner, with about 16-candle gas, consuming 4 cubic feet gas per hour at 1-inch pressure, gave 70 candles, or 17 candles per foot

Experiment No. 2—The same Auer burner supplied with "Selas" gas (air 2, gas 1), employing the ordinary mantle, under a pressure of 2¼ inches = 12 cubic feet per hour mixture = 4 cubic feet gas = 105 candles = 26 candles per foot, as against 17 candles per foot with ordinary gas.

Experiment No. 3—A "Selas" large burner, consuming 6·6 cubic feet per hour mixture = 2·2 cubic feet per hour gas = 60 candles = 28 candles per foot.

Experiment No. 4—A "Selas" normal burner consuming 4·8 cubic feet per hour mixture = 1·6 cubic feet gas = 47·5 candles = 29 candles per foot.

The comparison between the Copenhagen and Flensburg results is very interesting, as it shows (*a*) that the "Selas" gas, even when consumed in a wasteful mnaner in the "C" Auer burner, yields results greatly superior to the ordinary Auer burner consuming ordinary gas, and (*b*) that to obtain the best results from the "Selas" flame, small mantles and small burners must be used, or, in other words, the diminished flame due to the mixture of air and gas must as nearly as possible fit the mantle, and, furthermore (*c*), that, under certain conditions, the lower the initial illuminating power of the gas the higher the flame intensities. In the case quoted, the lower-power Copenhagen gas contained probably a large percentage of water gas (enhancing its flame-intensity , whereas the Flensburg gas contained none. However, the average of the results obtained by independent observers in Germany, Denmark, and Sweden, point to the fact that 18 candles seems to be the maximum yield per cubic foot of gas consumed by the ordinary "C" Auer burner, whereas the same gas, aërated in the proportion of 2 of air to 1 of gas, yields on an average from 34 to 36 candles per foot. What this implies in economy to the consumer is self-evident; and the charm of the whole question lies in the fact that whereas in many instances large quantities of gas must be consumed to yield a high rate per cubic foot, in the "Selas" gas the highest effect is obtained by a minimum consumption. Hitherto the comparisons have been made between the "C" Auer burner and the "Selas" flame; but compared with the "Kern" flame, the results work out (with low-pressure "Selas") at 25 candles per foot for the Kern, and 34 to 36 candles per foot for the "Selas."

High-Pressure "Selas" Gas.

In Berlin, the Kleine Thiergarten is lit by the high-pressure "Selas" system; and the results are approximately as follows: Pressure, 35 inches of water. Mixture, 1 of air to 1 of gas = 44·6 cubic feet of mixture per hour = 22·3 cubic feet of gas = 987 candles = 44·2 candles per foot. The power required to supply the 75 burners of 987 candles each is only a 1-horse power gas-engine, consuming (say) 30 cubic feet per hour, or an electro motor of 700 watts. Of course, the mantle question enters very much into the matter of efficiency. They must be renewed every six weeks. The installation is under the control of Herr Director Schimming, of the Municipal Gas-Works, Berlin, and the results are believed to be the highest yet attained in the history of gas lighting.

There are several sizes of high-pressure "Selas" burners constructed; the smallest consuming under 35 inches of pressure, 26 cubic feet of mixture per hour = 13 cubic feet of gas = 520 candles = 40 candles per foot.

Although the flame in this instance is of much greater volume than the small low power "Selas," yet the effect in intensity per cubic foot consumed is not greatly superior to the low-pressure flame. This is due to the fact that, under a pressure of 35 inches of water, the flame intensity of a mixture of 2 of air to 1 of gas is so enormous that no mantle at present manufactured can withstand it; so that the mixture therefore of air and gas is reduced to the proportions of 1 to 1. At present the durability of the mantle bars the way to further development of heat intensities.

Commercial Results.

This, after all, is perhaps the *crux* of the "Selas," or, in fact, of any system introduced for providing the consumers with better light; and the "Selas" has long since passed the experimental stage and has become a commercial success. There are many (several hundreds of) installations at work on the Continent; and the results are everywhere appreciated. The three following authenticated facts are culled from many gas accounts, and show the very great economy in gas used.

Result No 1.

The cloth calendering steam mills belonging to Messrs. Geo. Schleber and Co., of Greiz, Saxony, used in the years 1898-1899 ordinary Auer burners; the account for gas being

1898	453,357 cubic feet.	Paid	£128 18
1899	389,923 ,, ,,	,,	110 9

In 1900, the "Selas" system (both high and low pressure) was installed, with these results:

1900	188,500 cubic feet of gas.	Paid	£53 8
Saving as against 1898 account		=	75 10
,, ,, ,, 1899 ,, ...		=	57 1

In 1901, 40 additional "Selas" high-power flames were added, with an enormous increase in illuminating power; the commercial result being

1901	272,704 cubic feet of gas.	Paid	£76 18

In 1898, an effective illuminating power of about 8 million candles cost £128 18s.; whereas in 1901, after adopting the "Selas" plant, over 10 millions of effective candle power were obtained for £76 18s.

These figures speak for themselves; and the installation (a most perfect one), as well as Messrs. Schleber and Co.'s books, are open to the inspection of anyone concerned. Furthermore, previous to the adoption of "Selas" light great difficulty was experienced in judging indigo colours by artificial light; whereas, after the introduction of the new light, the writer is informed that the difficulties almost vanished.

Result No. 2.

[Hotel Wivel, Copenhagen.]

First quarter, 1902.	Gas account (ordinary Auer burners) .		£95 10
,, ,, 1903.	,, ,, (Selas system) . . .		38 0

with an increase of over 40 per cent. in lighting power.

Result No. 3.

[A large Café in Berlin.]

Gas Accounts.

1899, with Auer lighting—		1900. with "Selas" gas—	
April	£22 8	April	£13 11
May	16 8	May	9 5
June	18 16	June	9 5
	£57 12		£32 7
69 Auer burners at 70 candles each = 4830 candles.		69 "Selas" burners, at 97 candles each = 6873 candles. The burners in this case consumed 7·9 cubic feet of "mixture," or 2·65 cubic feet of gas, and gave 36 candles per foot. The consumption of the Aur burners previously used was about 4 cubic feet per hour.	

This apparatus has worked since 1899 without giving trouble or needing repairs.

The plan hitherto adopted by the "Selas" companies is to hire the apparatus to the consumer for three years at a time, at a tariff of 5s. to 6s. per burner per annum; the company contracting to keep it in working order and to look after and renew the mantles at the nominal price of 2d. or so. This appears to be a satisfactory arrangement, as the consumer is relieved of all trouble. Sometimes the "Selas" companies agree to receive half the value of the net saving in the gas account as payment. This generally tickles the fancy of the consumer, and it pleases the "Selas" people; but both watch the meter and the account as a cat watches a mouse!

In conclusion, several have inquired why the writer, a purveyor of gas, is enamoured of a scheme which presumably tends to check the consumption. The reply is: We gas people have the common enemy electricity to fight, and

any sound system which benefits the consumer and puts him in a good humour (if this is possible) with his gas bill should be encouraged?

At the conclusion of his paper,

Mr. MARSHALL said he desired to express his thanks to the Directors and officials of the Gaslight and Coke Company for the privilege of fixing up his apparatus at their offices. He was further indebted to Mr. Trewby and Mr. Goulden for the enormous pains they had taken in endeavouring to verify the results he had obtained on the Continent. He had there met with very great difficulties, especially in the case of the high-power lights, on account of the imperfection of the photometers. He had been very highly gratified at being able to demonstrate the possibilities of this apparatus by the aid of the "Flicker" photometer placed at his disposal by the Company, especially in measuring the lamps approaching 2000-candle power. He found that with this instrument these high intensities could be measured as easily as 16-candle gas with an ordinary open photometer.

LATER DEVELOPMENTS IN HIGH-PRESSURE LIGHTING.

By A. W. ONSLOW, of the Royal Gas Factory, Woolwich Arsenal.

The preparation of this paper has been a difficult one for the title to be justified. "Later developments" imply a great deal, if the paper is expected to go over the ground of all recent innovations, or made interesting to the gas engineer.

The first question is: Does high-pressure gas lighting justify its existence from an economical and useful standpoint? The answer can at once be: Yes; and, further, it is a lever to counterbalance rivals. I cannot help looking upon high-pressure gas lighting for industrial purposes as a most valuable asset, combining the power of the electric arc, the advantages of the incandescent system, and the cheapness almost of daylight itself. This cannot be better exemplified than by taking two systems of lighting—namely, by the electric arc and flat-flame gas-burners—and detailing the recent lighting of a building by high-pressure gas.

One of the most brilliantly illuminated buildings I have ever seen was lighted by electric arc lamps, with flat-flame burners at the benches. The light was painful to the eyes, and was by no means satisfactory, besides being most costly. Another building has had its flat-flame burners reorganized during the past two years, but nothing in the shape of an application of incandescent lights. In the case of the above-mentioned electric arc lighting, opportunities are offered for high-pressure lights; but in the latter one, splendid opportunities for an enterprising electrician.

Against the building with the electric arc, I have in mind a new building and offices lighted by high-pressure gas for about 250 men, and with not a single flat-flame burner. The ground space is 22,500 feet superficial, lighted by sixty 400-candle power lamps, with a total developed lighting power of 27,900 candles, or 1·24-candle power per foot of floor area. The lamps hang 8·6 feet from the floor, and not a shadow is discernible. The actual cost per hour is—

	s.	d.
Gas	2	1·2
Attendant	0	6·0
Mantles	0	6·0
10 per cent. depreciation and 5 per cent. on the capital invested	0	8·6
Total	3	9·8

or 0·18d. per hour per man during the lighting hours, estimated at 1000 per annum. When one contemplates that in a certain establishment the piece-work had to cease after dark, owing to the inability of flat-flame burners to suffice, and that this same place is now well lighted throughout by high-pressure gas at a much lower cost than before, this alone would justify its existence.

The main object in lighting a building is to take the place of daylight, as nearly as possible, without shadows, blinding rays, or the many defects associated with artificial light. The photographs [see p. 797] show part of a factory so lighted. The time exposure was two minutes, and it was taken on a dark night. Through the kindness of Messrs. T. Glover and Co., of Upper Edmonton, the photographs of their works will give some idea of the value of gaslight. Under such conditions, as shown by the photographs, winter days and nights can be looked upon with equanimity. The main object has been to simplify working parts, so that when once an installation has been completed, the services of a skilled man are unnecessary to maintain it efficiently.

In order to estimate the power required for an installation of about 200,000 candles, I am taking the rotary compressor or blower with bye-pass valve, which permits of any pressure up to 5 lbs. per square inch being easily obtained; and it is the most economical in working that I am aware of, besides being easily adapted to taking diagrams. At the time of the test, 166 lamps were used, having a lighting power of 89,000 candles. A 3-inch main leads up to two 3-inch anti-fluctuators, joining into one 3-inch pipe at the compressor itself. There are 3-inch connections on the outlet and 2½-inch pipe, the full length of the building 363 feet. The inlet pressure before starting was 1 inch.

The power was furnished by an electric motor; the gas-engine for another installation of 500,000-candle power not being ready for taking diagrams. The power at 24 and 28 inches pressure was the same—viz., 7·75 amperes, or 2·65 B.H.P. At 20 inches pressure the power went down to 7·1 amperes, or 2·43 B.H.P. On closing down one of the anti-fluctuators, the 20 inches pressure became 19 inches, with 6-10ths exhaust on the suction or inlet side between the anti-fluctuator and compressor. The power required was 7 amperes, 2·39 B.H.P. On closing down 18 lamps, the pressure became 20·2 inches, and the exhaust 2-10ths; with 28 lamps closed, 20·5 inches and the exhaust 1-10th; with 40 lamps closed, 20·7 inches, with the exhaust level, as is the case in all further results; and with 50 lamps closed, 20·8 inches pressure.

The power required at this stage had gone to 6·75 amperes, or 2·32 B.H.P.; but with 60 lamps closed it was 6·5 amperes, or 2·22 B.H.P. With 100 lamps closed, the power increased, owing to some reason, to 6·8 amperes, or 2·32 B.H.P., and the pressure became 21 inches; with 110 lamps closed, it was 6·8 amperes, 2·32 B.H.P., and pressure 21 inches; with 130 lamps closed, 6·8 amperes, 2·32 B.H.P., and pressure 20·9 inches; with 140 lamps closed, 6·5 amperes, 2·22 B.H.P., and pressure 21·3 inches; with 150 lamps closed, 6·5 amperes, 2·22 B.H.P., and pressure 21·5 inches; with 160 lamps closed, 6·5 amperes, 2·22 B.H.P., and pressure 21·5 inches; and with all the lamps closed, the same result as the last. Diagram A [see next page] shows the above results; but the paper had to be adapted to the working conditions.

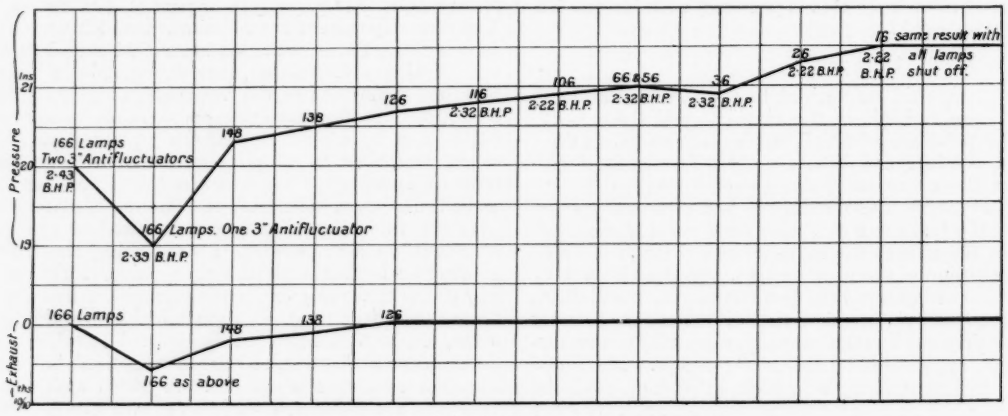
Summary of Power Required.

At 20 inches pressure, both anti-fluctuators at work	7·1	amperes, or	2·43	B.H.P.
Motor running on loose pulley	4·0	,,	1·37	,,
Actual power required to obtain 20 inches pressure from 1 inch	3·1	,,	1·06	,,
The motor itself absorbed	2·0	,,	0·68	,,
The shafting necessary to break down from 1400 revolutions to 220 per minute	2·0	,,	0·68	,,

So that had the drive been a direct one from a shafting, the 2·43 B.H.P. would have become 1·06 B.H.P. to do the actual work. The compressor running with open inlet and outlet required 6·0 amperes, or 2·04 B.H.P. The actual difference between this and the work put forth for 20 inches pressure represents only 1·1 amperes, or 0·39 B.H.P. I am unable at the present time to give the horse power of the several installations; but if interesting to you, Colonel Sale or I will be pleased to supply the figures through the Technical Press. The light is not dependent entirely on the motor, as a belt is connected to a main shafting, and in the event of a failure the light can be at once supplied from one or the other. The action with two anti-fluctuators at work and 20 inches pressure represents a level exhaust gauge, and no diminution in the pressure, showing the necessity for ample mains, &c.

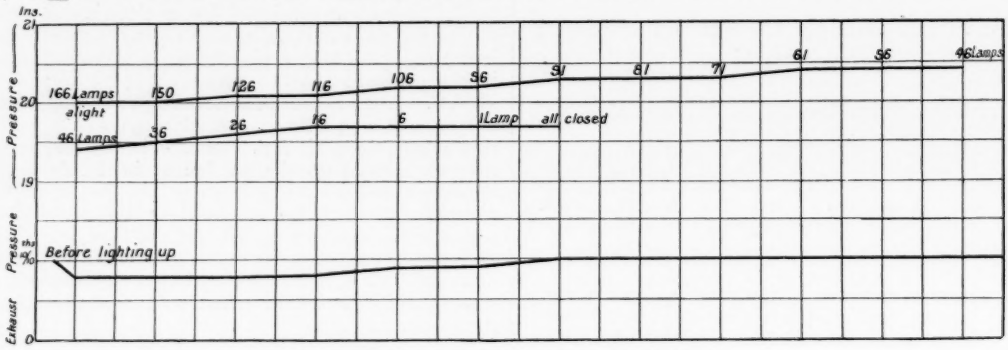
Diagram B shows the pressure on the inlet of the anti-

CHART A.—*Exhaust and High-Pressure Chart with One 3-inch Anti-Fluctuator at Work.*



The Exhaust Gauge is on the Outlet of the Anti-Fluctuator.

CHART B.—*Exhaust and High-Pressure Chart with Two 3-inch Anti Fluctuators at Work.*



The Exhaust Gauge is on the Inlet of the Anti-Fluctuators.

fluctuator, and the difference in the pressure side on closing down the lights, thus—

Lamps Alight.	Pressure. Inches.	Inlet to Anti-fluctuator.
166	20·0	8-10ths.
150	20·0	,,
126	20·1	,,
116	20·1	,,
106	20·2	9-10ths.
96	20·2	,,
91*	20·3	1 inch.
81	20·3	,,
71	20·3	,,
61	20·4	,,
56	20·4	1 inch.
46	20·4	,,
36	20·5	,,
26	20·6	,,
16	20·7	,,
6	20·7	,,
1	20·7	,,
All lamps closed.	20·7	,,

The blower is actually larger than necessary, in order to provide for furnaces, gas-heaters, &c.; so that for a 200,000-candle power blower only, the power would be even less than the above.

To ascertain on some definite basis the quantity of gas to be obtained from pipes, it was found, on working a very small compressor (without anti-fluctuators) having a $\frac{3}{4}$-inch bore inlet and outlet, that on starting the machine the pressure in the main supply was 12·10ths. This was reduced in the service at the machine itself to a level gauge line, with $8\frac{1}{2}$ inches on the high-pressure side, and 300 cubic feet of gas was passed per hour. Now by accepting Barlow's table, a correct solution was arrived at in the following manner: At 12-10ths pressure in the main, the table showed that 508·6 cubic feet of gas would pass per hour; with 2-10ths pressure, 208·6 feet per hour; the difference, 300 feet, is the actual consumption to bring the gas from 12-10ths in the main to level gauge at outlet of pipe. This result was obtained after various tests had been made, in order to arrive at some means for ascertaining the capacity of service pipes for high pressure when connected to large mains.

* It should be noted that the 91 lamps were consuming 1460 cubic feet per hour without any reduction of pressure on the inlet side of the anti-fluctuator. The 166 lamps consumed 2688 cubic feet per hour; so that between 91 and 166, the pressure was reduced 2-10ths. The difference between 10-10ths and 8-10ths, according to Barlow's tables, represents 704 cubic feet; but we consume 1460. Had the number of lamps been increased for another 1066 feet per hour the pressure would represent a level gauge for the remaining 8-10ths, or a total passing of 3754 feet per hour.

One of the machines in use having a 4-inch inlet and outlet connected to a 6-inch main would at 8-10ths pressure therein, and no meter to obstruct the passage of gas, throw 10,646 cubic feet per hour to bring the pressure on the inlet down to level gauge; or a 10-inch machine on an 18-inch main would, at 125 yards, deliver 116,846 cubic feet of gas per hour before the inlet showed the level gauge also. This machine would be capable of doing 200 per cent. more work if gas were available at a higher pressure than 8-10ths; thus leaving a working margin for bringing up the pressure to 28 inches if required.

The necessity for adequate gas-pipes is apparent, and although the compressor may be a useful article for drawing gas and bottling it up for use, too much must not be expected of it. With the above practice, it is easy to estimate for the requirements of an installation by allowing 15 per cent. for compressing the gas in pipes. The bye-pass valve must be looked upon both as a governor to be weighted as required, and a relief-valve for passing the surplus gas back to the inlet.

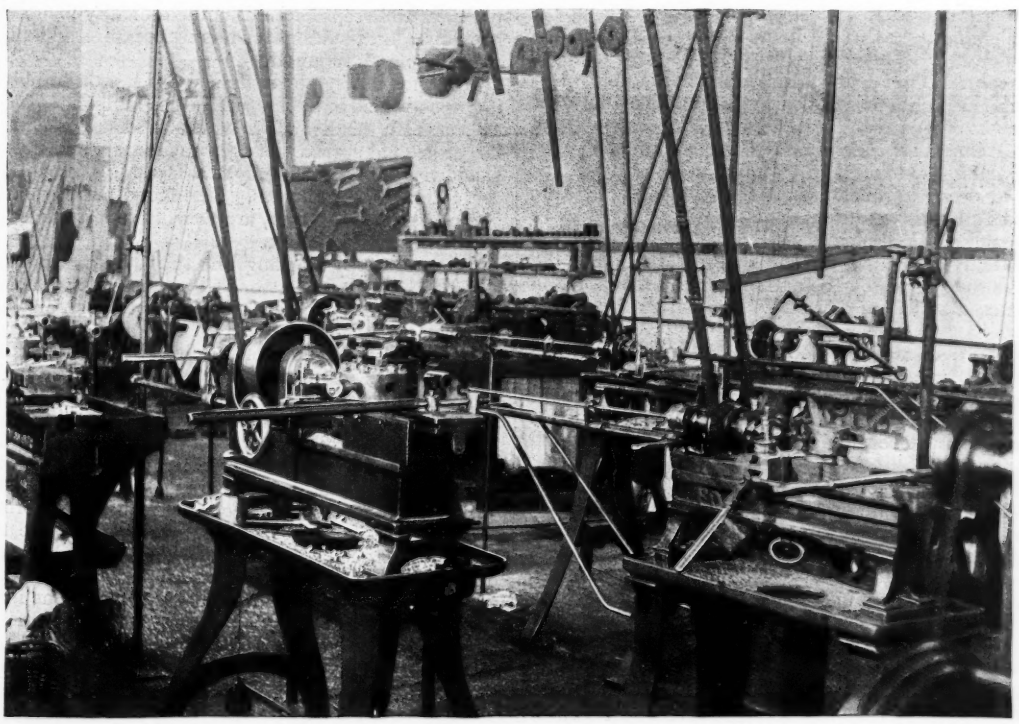
Let us now turn to the burners. The requirements in a burner are many. It must not light-back under low pressure; the hissing noise must be fractional; and all parts subjected to heat must be of a material capable of withstanding the high temperature necessary for the light. To arrive at the stage we are now at has been long and tedious. Every difficulty had to be settled as it arose, as there were no text-books to guide one; and if the pressure and conditions were to be in advance of other systems, I leave to your imagination what had to be overcome.

The mantle-rods were found to bend and fuse with the heat, until a nickelled steel rod of the proper composition was found. The gauze must be of a suitable texture, and the material nickel. Much hissing is caused by the gauze. The alteration in the minutest dimension causes a whistling noise which is simply unbearable at 30 inches pressure. In one installation, the pressure was started at 20 inches; and not until 44 inches was reached was perfection attained. But the lighting-back at 5-10ths pressure took place, and, of course, this had to be overcome. During meal hours the valve provides for opening by a light aluminium flap

PHOTOGRAPH TAKEN BY HIGH-PRESSURE LIGHTING AT THE NEW WORKS OF MESSRS. THOMAS GLOVER AND CO., LTD.

immediately the compressor stops—to maintain the light in a burner at the inlet pressure. This is closed again by the action of the higher pressure. No difficulty is therefore experienced if the machine should fail, beyond the temporary loss of the higher illuminant.

The air supply of a burner is a most important matter. I prefer a wide-bottom burner to the attenuated style of the Kern. It has been the practice to supply the air to a bunsen burner at the same level as the gas nipple; but if the nipple be thrust well up in the burner with sufficiently large air space, a much better effect is produced. The air and gas become well mixed and heated before combustion takes place. In one instance, the top of a burner fused in 12 hours, due to the mixed air and gas being so near the turning point; and I am led to believe it was due to the nipple being placed too high in the burner. The heat became very great; and though the burner at the time was giving some 800-candle power, the light had to be sacrificed to utility, in order to prevent such a thing again occurring. The latest burner of this description is giving, at 30 inches pressure, according to the test and certificate of Mr. Dibdin, 510 candles, or 33·1 candles per cubic foot of gas, with a burner



PHOTOGRAPH TAKEN BY HIGH-PRESSURE LIGHTING AT THE NEW WORKS OF MESSRS. THOMAS GLOVER AND CO., LTD.

equal in size to a No. 4 Kern; and 100 candles for a No. 0 burner, or 35·7 candles per cubic foot of gas consumed. These results are on the basis of the standard prescribed by the Metropolitan Gas Referees.

On reaching (say) 20 or 30 inches pressure, much gas is wasted by an unsuitable mantle. The mantle must be double woven, or very thick in texture, so as to compel the gas to remain in a confined area. The neck of the mantle should be small for the same reason. A straight mantle, with large opening at the top, is conducive to the flame passing through the top, helping to fuse the rod and deteriorating the lighting effect. This difficulty, together with other points, has been overcome.

The study of the life of a mantle is rather instructive. Where one is in use about two hours daily, the life is 150 working hours at 400-candle power; but if used all night, or from 12 to 14 hours daily, the limit has reached 400 and 500, and occasionally 600, working hours. The low length of life may be due to a careless lighter, and not to actual usage. A safe plan is to light the burner above the lamp. A life of 400 hours for 400 candles with the new burners can be looked upon as normal; but if 500-candle power or upwards is required from the same mantle, the life is materially reduced. This can be looked upon as a natural course when one burner is doing the work of two, and the power per cubic foot of gas is maintained.

Much blame for deteriorated light has been attributed to the mantle. This should not be accepted fully, as it is generally caused by defective burners. This is particularly so with high pressure. A burner and mantle are made for certain pressures. The air supply will, if excessive, reduce the light as much as 200-candle power. In one instance, a mantle was said to give no light at all, although a large volume of gas was passing through the burner. But if the burner and mantle are cared for with ordinary intelligence, a change in the lighting effect should not be perceptible from one month to another. To some extent, lamps suited to 500-candle power burners have been difficult to obtain. A 250 to 300 candle lamp is a trade article. Closed-in lamps for open spaces 18 inches square are used; and in buildings not subjected to severe wind draughts, a lamp with open bottom, hexagon shaped, 16 inches wide, will hold two burners if required. This is an advantage, without increasing the cost to any extent.

All lamps and burners are suspended on springs with flexible steel tubing. The earliest recollections, some four years ago, of mantle destruction through roof and ceiling vibrations and heavy gun-firing were painful; and it was only by procuring a steel wire spring and a flexible pipe—the lamps swinging at their own sweet will—that the destruction ceased. This has never been improved upon. Wherever there is the slightest oscillation, the lamp or pendant is suspended on a delicate spring well above the heat. In some cases lamps have oscillated up and down 2 and 3 inches. Lamps suspended upon wire rope in open yards frequently suffice without springs; but in such places as proximity to steam-hammers, where the vibration affects the ground and buildings to a great extent, springs are added to wire rope counterbalanced.

One great advantage gained by high pressure is that the bore of the supply-pipes on the pressure side is reduced, and need not exceed half that in ordinary use, unless fixed over long spans. A ½-inch pipe 80 feet long will supply eight 500-candle burners without reduction of pressure at the farther end. One installation for a hundred and sixty-five 450-candle lamps has only a 2-inch pipe for the main supply. This is, of course, a large saving in first cost. Particular care must be provided to give each burner its full share of pressure.

The system adopted for a new building is to provide all pipes under high pressure with reducing valves where necessary, to be in the control of a workman, so that on lighting up the valve is slightly closed or opened if required under low pressure. The valve provides for gas fires, furnaces, &c., and to be sufficiently under control, so as not to interfere with work when either low or high pressure gas is used. The flap-valve already described allows for low-pressure gas in daytime. After making allowance for the gas to be used for high pressure, the quantity for other purposes must be estimated, so that the machine will serve all purposes without interference.

As each difficulty in this and other respects arises, we have to deal with it; but at the present time we are in the particularly comfortable state of having no difficulties on hand. In all our installations there is provided a reserve of 100 to 150 candles per burner, which can be utilized on the addition of more pressure. This is done by closing the relief or throttle valve, or increasing the speed of the compressor; and as the increased pressure does not materially affect the brake horse power required, the matter is a simple one.

Every burner, mantle, and machine is looked to daily during lighting hours, and overhauled once a week. One fitter and labourer can attend to 500,000 candle power, and easily do all the repairs to the fittings generally. Each installation is provided with printed instructions, and a man is shown how to open and close the output so that it is in the hands of that particular branch apart from the gas-fitters. In three minutes, the largest installation is lit up.

The day for flat-flame burners is passing quickly, and must give way to their modern rival, the incandescent mantle, both on economical and increased lighting grounds. The conversion of the old into the new form is only a matter of expenditure. The question of funds is uppermost, and the time for the conversion comes next. Where high-pressure lighting is installed to suit the exact requirements of the place, and then carefully attended to, there need be no fear as to its being superseded by any other form.

Conversion is now done by using up the existing pipes, first testing for leakages, and removing superfluous pipes and fittings. In testing, the pressure must stand for two minutes—any falling in the water-line of the gauge being sufficient to condemn that branch to a thorough overhaul, whether with new or old pipes. Each length of pipe is controlled by a well ground-in stopcock, easily reached from the ground, in addition to the nose-cock at each burner. Cup-and-ball joints are avoided, unless supplied with specially strong springs, owing to their liability to leak.

For temporary lights, long lengths of steel flexible hose are used, having the joints fitted with rubber bands to prevent leakage when bent. These pipes are put under a pressure of 5 lbs. per square inch, and placed under water. Should any bubbles appear, that part of the pipe is cut out; and if there are many small leakages, the pipe is condemned altogether. A copper flexible hose can be used for outside work, owing to the liability of steel hose to become rusty and unserviceable. We have instances where one compressor controls several different branches—each branch lighting up and extinguishing to suit the particular purpose; and as dry meters can be made to stand from 20 to 30 inches pressure and record correctly, the difficulty is minimized by providing local stations for raising pressure, and distributing it to the places required.

A higher candle power than 500 is not desirable for lighting open-roofed buildings, unless the lamps are placed about 12 feet from the floor-line, as the tendency is then to give larger ground surface between each lamp, and thus produce shadows. For rooms (say) 12 feet high, use from 200 to 250 candle power burners. The No. 0 burners, giving from 70 to 100 candle power, are very useful for offices, or fitted in clusters to give effect.

After carefully working out this system compared with all others, it is found to be the cheapest and readiest to hand. The author has tried high-pressure air with low-pressure gas; but the cost goes up about 50 per cent. in material, owing to two sets of pipes being required. There are variations in pressure in the low-pressure pipes to be considered, which materially affect its usefulness; but its advantages are that great pressure can be brought to bear at the burner—thus increasing the force there in the form of a blast pipe. The unfortunate mantle, however, has a short and very sad life—20 hours being a long existence.

So long, therefore, as we can easily beat any form of electric light in first cost by four to one, and three to one in upkeep, there is no superhuman effort necessary. I am only aware of the high-pressure system breaking down on two occasions: and the mishap was due in one instance to the meter becoming short of water, and in the other to neglect of lubrication.

[Mr. William Sugg then read a paper describing his latest improvements in high-pressure lighting. The paper was only incidentally alluded to in the discussion. Its

publication is postponed till next week, when it will be given together with the two succeeding papers—those by Mr. Arthur Valon and Mr. J. Ballantyne.]

Discussion.

Mr. CHARLES CARPENTER (London) said it would have been interesting if Mr. Goulden or Mr. Trewby had opened the discussion, as these gentlemen had had an opportunity of checking the results with the photometer, which gave more reliable and concordant readings than the instrument with which Mr. Marshall had been working. The results he gave with the "C" burner, working with the ordinary gas, were somewhat extraordinary. The readings were extremely erratic—varying from 47 to 85 candles; and if a similar instrument was used by Mr. Marshall in getting the values of the high-power burners, he feared that to a considerable extent it discounted the value of the results. He would further ask whether the candles referred to were English candles or the Hefner candles which were generally used on the Continent, because this would have an important bearing on the values he gave. The high-pressure arrangement which he used was extremely interesting; and the illuminating value per cubic foot was very high. With a simple high-pressure arrangement by which gas only was raised to a high pressure without any admission of air, as in the "Selas" burner, they had obtained over 40 candles per foot—41 candles was the highest they reached. But when they came to high duties such as this, the question to be considered was not whether it was possible to increase it by 2 or 3 candles, but whether it was practicable to simplify the apparatus and method of achieving such results. If they could increase the duty to only 40 or 45 candles, what they had to consider was not whether this in itself was advantageous, but rather whether the results could be achieved with an apparatus of equal simplicity, or of greater complexity. The great difficulty that he experienced in dealing with incandescent lamps of this magnitude was the duration of the mantles. Mr. Marshall said that they required renewal every six weeks. He did not know whether this meant a continuous burning for six weeks or during the ordinary lighting hours. It would be interesting to have, in lighting hours, the average duration of the mantles. One of the most important things in estimating the value of various systems of high-pressure apparatus or mantles of different makes was the question of the photometer, and, in order to make experiments which were of any value, they had to devise a special photometer. It was one which, in conjunction with Mr. Helps, he proposed to describe at the International Photometrical Congress to be held at Zurich; but the principle of it was the use of a secondary standard of the same quality and intensity as the light with which the comparison was required to be made. With Mr. Marshall's concluding remark he cordially agreed. Their great desire should be to show at how cheap a rate they could supply gaslight, whether high or low pressure, or in any other form. He welcomed any substantial improvements which would increase the result, and bring it about with greater simplicity. For some time past, they had been letting out high-pressure apparatus of one or two kinds on the hire-purchase system, and maintaining burners and mantles at a fixed rate per annum. The maintenance was worked out so as just to pay expenses, and leave little or no profit; so that the consumer obtained the full value of the saving in gas. They had put up various plants in different parts of the district—some in drapers' shops, tailors', public-houses, underground conveniences, railway stations, and all sorts of places—and in every case the plan had given satisfaction. But also in every case they were careful to keep the maintenance in the hands of the Company. Among others, they had used the apparatus Mr. Sugg had described. They owed a great deal to Mr. Sugg, for his persistent efforts to bring high-power lighting by incandescence under the notice of the authorities. He might cite particularly one or two examples of the installations with which he had been intimately connected. There were the great bridges across the Thames—the Tower, Blackfriars, and Southwark Bridges. All of these were lit by high-pressure gas furnished on Mr. Sugg's plan; and from all sources he had heard nothing but praise of the manner in which the lighting had been carried out. One of the members of the City Corporation some time ago told him that, as far as his observation went, the lighting of Southwark Bridge was better than that of Blackfriars. Now, the apparatus was the same in the two cases—the burners were the same, the mantles were the same, and the same men kept them in order. But on Southwark Bridge the South Metropolitan 14-candle gas was used, and in the other case the gas was supplied by the Gaslight and Coke Company. Judging from the view expressed by this disinterested observer, the latter did not give such good value in a high-power incandescent burner as plain, simple coal gas.

Mr. THOMAS CANNING (Newport) said these three papers contained a deal of very important and useful information; and there seemed to be two things brought out very prominently—namely, that with respect to intensifying gas, compressors and motors must be used if the best results were to be obtained; and, secondly, the fact that some very considerable improvement would have to be made in the mantles. He was much struck by some of the suggestions thrown out by Mr. Onslow—especially his method of suspending the lamps and overcoming the great difficulty from vibration, which must be enormous in the places where he had to employ the system. He was not going into particulars with regard to the system. His principal object was to say a word or two with reference to Mr. Marshall's paper. They had heard from their old friend Mr. Sugg (whom they were always glad to see) about the difficulty he had at Bristol with respect to getting the Water Company to supply water to the motors. No doubt, it was very stupid; but the same objection was met with elsewhere. Mr. Sugg said he did not know why they objected; but the case had been put to him by someone connected with the Water Company, that it was because they were afraid their water would get polluted by coming in contact with the gas. Of course, he showed there was no need for any such fear. With regard to Mr. Marshall's paper, he only wished to obtain a little fuller information; and to elicit this, he would give some of his own experience. Mr. Marshall did not apparently make any allowance, or did not show any, for the gas used in the gas-engine, or for the cost of current in the electric motor. But it might be he was wrong, and that it was included somewhere in the figures. Again, he did not put down anything for sinking fund, depreciation, or anything of the kind, on the original cost of the motors. He gave the statement that 10 millions of effective candle power were obtained for £76 18s., which certainly was a very good result. He was going to give some results obtained by another system, which appeared to him to be equally good; and his reason for bringing it forward was not because he was not in sympathy with Mr. Marshall's invention, for he was, and also with Mr. Sugg's, and with every new invention which could be brought out in this direction. The more they had the better. In the beginning of the year 1902, a large tradesman at Newport, who had a long arcade or corridor, had it lighted with electricity. He was also a member of the Corporation and of the Electricity Committee of the Town Council. He was not pleased with his electric lighting; and they might take it for granted that he must have made some overtures to the Electricity Department before he decided to give up their light, which he did. This place was illuminated by 6 large arc lamps and 65 incandescent lamps. For the quarter ending December, 1901, the bill for electricity was £37 2s. 6d. For the corresponding quarter in 1902, the state of affairs was this: The 6 arc lamps had been replaced by 15 Keith and Blackman 300-candle power incandescent gas lights. The arc lamps were discontinued for the whole of the December quarter; and this was the reason why he had taken out these two quarters, because they formed a good comparison. His bill for electricity without the arc lights was £19 1s. 6d.; and consequently these lights themselves cost £18 1s. In other words, the gas was to reduce the bill for electricity by £18 1s., or about one-half. These arc lamps were described to him as being inefficient. Though they were very powerful lamps, they were very uncertain in their action. They frequently went out, and were constantly jumping. The lighting by gas turned out perfectly satisfactory; and there were no complaints about it. On the contrary, it was even far more efficient than the electric light. There was this also to be said. He had been informed that on many occasions, the lights being so good, it was quite unnecessary to keep on more than one-half of them. Anyhow, the cost for gas during the quarter, for 37,600 cubic feet, was £5 12s. 9½d. The mantles cost 7s. 6d., and the water 5s.—making a total of £6 5s. 3½d., against the £18 1s. spent in

electricity. So that, roughly speaking, the actual cost would have been about one-third that of the electric light. He would add to this (say) £1—making £7 5s.—for interest and sinking fund on the motor, which was more than sufficient. He took it the 37,600 cubic feet of gas consumed under the system he described, even putting the duty per cubic foot as being lower than 30 candles, represented as nearly as possible a million effective candles. Taking Mr. Marshall's method, therefore, ten times this amount—namely, ten times £7 5s.—would be the equivalent for his 10 million effective candles, which he worked out at £76 18s. But under this system, it would work out at £72 10s. It was very nearly the same; but the system which had been brought before them that day did not appear to him to be doing very much better than was being already done by a method which had been used pretty largely. He could say that since the installation he had referred to was put up, orders were continually coming in from laundries, printing establishments, and other places—in fact, wherever there was a sufficient demand for a large enough quantity of gas to make it worth while to put down the motor. The great point which seemed to stand out from all three papers was that intensified gas was, and would become more and more, useful; and he hoped that in the end it would oust electricity for certain classes of lighting, which could be far better done by intensified gas. It had been said that this would be their most powerful agent in competing with the electric light. That was so, providing they were competing with the electric light supplied under commercial conditions. If they were competing with electricity supplied by a company who had to pay rates and make a profit, and publish accounts which people could read and understand, then they might be quite safe in dealing with their competitor. But if they were competing with electricity supplied under different conditions—where profits were seldom or never made, but where they could be shown to be absent—if they were competing with a concern that paid no rates and sometimes could make offers in the market against them at a price lower than the cost of production, then, no matter what apparatus they had in their hands, it could not be a competitor. They must first take the opportunity of seeing and understanding whether or not they were really competing with a concern carried on under commercial conditions. He believed this would be the case more in the future than in the past, and that more and more care would be exercised to see that these concerns were carried on, as they should be, under the proper control of commercial men who worked them, not from any view of gaining some credit for themselves that they were making the concern pay, but that they worked it as commercial men would work it and under commercial conditions.

Mr. John West (Manchester) said he had been very specially interested in these papers, because it was a subject in which he took great interest in his younger days, and had followed it right through, and felt as much interest in it to-day as he ever did. He believed the interests of gas companies and consumers were identical, and that this was a step in advance. There were one or two questions he should like to ask Mr. Marshall. First, what kind of coal the gas was made from with which he conducted his experiments, because if it were made from Durham coal it had one value, but if from some German coal he knew of it would have a very different calorific value. Next, with regard to the mantles. This question appeared to him very important, and might affect the results of the various experiments. He had an impression himself, from various observations he had made—especially on the Continent—that there were mantles and mantles; and some were very much better than others. He also had the impression that the mantles one saw abroad were somewhat better than those they had in England, taking them on the whole. He found they were used more universally abroad than they were at home—which was quite natural, because Germany was the birthplace of the mantle, and they got them cheaper in the earlier days. One seldom saw anything except an incandescent gas-burner in Germany. He thought they should always learn from what they saw around them; and in talking about lower candle power gas, he was quite at one with Mr. Marshall and several others, and believed in lower grade gas. Why should they make rich gas, when they could get as much light from commoner and cheaper gas? Why should they waste money in enriching it, instead of giving the public the advantage of cheaper gas? From the first experiments he made many years ago with the incandescent burner (and he believed that he was one of the earliest to give the results of experiments), in testing 14-candle gas in one part of England and 20-candle gas in Manchester, he believed he got the same illuminating power with a mantle with the commoner gas as he did with the richer. This satisfied him that it was useless to manufacture richer gas, because they could make the poorer gas and sell it at a cheaper rate. The only thing impressed on his mind was that they should do as Mr. Marshall suggested—create more light, and give more light to the consumer. During all this long time, they found in various districts that the consumer was in an appalling state of ignorance as to the burner he should use. The moral to be learned was to educate the consumers and to make lower grade gas, especially if they were competing against electricity both for motive power and lighting purposes. There was no doubt a very great deal to be learned from Mr. Onslow's paper. He gathered that the one idea he had was supervision. These burners all had to be tested, and to be looked after regularly and systematically. He received some very instructive information on this point at Dresden some time ago. Looking round the place, he was much struck with the incandescent lighting; and night after night he got on the last tram and went round various parts of the city when nobody was about, so that he could see what was going on. He found nothing but good lights everywhere. He was very much interested in this, and inquired of a gas engineer how it was. He found it all resolved itself into supervision—daily supervision. He also found that their men were better calculated than Englishmen to carry out this supervision; that they had no difficulty with their workmen, because they were all technically trained. Referring to the mantles again, he found that some of the large companies, especially abroad, were making their own mantles. In Copenhagen, the Municipality made their own mantles; and they appeared to him somewhat better than those they purchased. Perhaps it might be feasible for some of the large companies here to do this for themselves, if they could not get other people to supply them with the best quality. He certainly thought this question of intensified light was one which had come to stay. A very beautiful illustration of it was seen at Manchester; it was all round the Technical School. A paper was read by Mr. Nasmith, one of the members of the Council, showing the advantages of the system; and he was sorry he had not got the figures with him. It was a most interesting subject; and their thanks were due to the three gentlemen who had read these papers.

Mr. T. Goulden, being called upon, said as he had not had the privilege of hearing the papers read, any remarks he could make would only be of a general character. He had heard Mr. West speak about mantles; and, irrespective of the various qualities of gas and the different calorific values, he should like to express his strong agreement with him that the mantles had very much to do with the efficiency obtained from incandescent burners. The experiments he had made showed clearly that they could get far more difference in using mantles that did not fit the burners properly, or mantles of varying qualities, than they could possibly get from any of the qualities of coal gas with which he had had to deal. He had had them of all qualities from 12-candle up to 18 or 20 candle, and even beyond that; and they could very much decrease the effect of even a high-power gas by having a mantle that did not fit the burner properly. To give an instance, he was testing with a London gas from which he got, with a properly fitting mantle, upwards of 22 candles, and in some cases even as high as 25 candles, per cubic foot. He had to renew the mantle; and he immediately obtained a result of not more than 16 or 17 candles—a difference of 33 per cent. At first he could not make out what was the matter; but on turning the mantle, he saw that it was loose round the burner-head, and the flame did not properly envelop it. He afterwards tried one or two, until he found one that fitted somewhat tighter on the burner-head, and up went the result at once to 23 candles. This fact ought to be seriously borne in mind, as it was a very important matter in connection with incandescent lighting. In fact, the proper fitting of the mantle, and its quality, were the two most important things. With regard to this intensified light, it was a matter of *quid pro quo*. They had seen results at the Gaslight and Coke Company's offices as high as 36 candles per foot with the "Selas" light on the high-pressure burner; but what the

low-pressure burner gave they did not yet know. It was evident, however, that this was not the maximum economy to be effected, because the adjustments were somewhat roughly made, and a good deal of the flame was being wasted. Most probably, they would get to about 40 candles. There was undoubtedly very great economy; for, taking the ordinary Welsbach efficiency at 12 or 18 candles per cubic foot, the light was doubled. This was a very significant factor to take into consideration, and it was one which must have its results on the serious competition they now had to meet. When he entered the room, he heard a gentleman alluding to the municipal competition they now had to deal with. They felt this very much in his own Company. They were paying rates in several very progressive districts; and he could not better exemplify the extent to which unfair competition went than by giving an example which ought to have the earnest attention of everyone connected with gas companies. They were paying very heavy rates in one district in the neighbourhood of Beckton. The district was now going in largely for municipal dwellings, and new roads had to be made to give access to them. But the authorities did not even put a gas-main down in the roads. They did not give the tenants the option of using gas, even for heating or cooking, but they wired the houses for electricity. The tenants had no option, but were bound to take the electric light. His Company had not even the chance of putting gas in; but they had to pay for all the loss which might accrue from the use of the electric light.

Mr. G. Stevenson (Long Eaton) said he had had a great deal of experience with the lights known as high-pressure lights—those alluded to by Mr. Sugg—particularly in lace factories, which had their gas from the Long Eaton Company. Two years ago, the Local Authority obtained a purchase clause to buy them out; but they came to the conclusion that they had only two or three years to live, and so declined to follow it up, and went in for an electric lighting scheme. Of course, wherever there was competition by a local authority it was very keen. In the lace mills of Long Eaton, a considerable quantity of gas was being used, because they worked very long hours—from four in the morning till twelve at night continuously; and, of course, this class of business was particularly well worth having. They used the old flat-flame burner on a swivel, so that they could put the light where it was wanted to see the threads—it being a very delicate business, and highly essential that the workers should have a good light. He conceived the idea that if they could sling a high-pressure light over the workmen's heads, so that they could alter the angle of the light, and see wherever they liked, they would gain a very material advantage over any form of electric lighting. He therefore put up an installation in one mill. He should say that the factories were mostly four storeys high, let off in separate tenements. There might be one factory with fifty tenements, each having its own meter and separate gas supply. He tried one installation, and though he was rather afraid on account of the vibration that it might not be successful, it came out all right. The gas was compressed by means of a power-driven compressor connected with the existing shafting, and provision was made that if there were only one burner alight, some of the gas compressed was bye-passed into the inlet main. This proved to be quite successful. The next question was how to compete with the electric light in this particular business. Eventually he canvassed the whole of the factories, and fixed up a big compressor at the inlet of the rising main of one of them, and thus put the whole of the gas under pressure. He had meters specially made so that they would measure the gas correctly at 15 inches pressure. Those who did not want the high-pressure lighting had to be dealt with by putting in a governor at the inlet, so that the pressure was reduced to about 2 inches. The method of attaching the lamps was by means of a flexible tube connected on the top of each lamp with a balance-weight attached, and hung from the rafters overhead. The lamps gave such a light as had never been seen before in a lace mill—the old flat-flame jets being a simple flicker in comparison; and the other factories which had the electric light were simply "not in it." Things went on very well until one day he had a complaint that some of the men were made ill by the light. Of course, he went to investigate the matter, and found out that with the high-pressure light a great deal of heat was given off. He tried to overcome the trouble by placing a glass barrier between the burner and the top of the men's heads; and he partially succeeded. But after a while the complaints became so frequent of headache, and so on, that he made up his mind that there must be some other cause than the high-pressure light. The electric light people of course were very glad of this difficulty, and immediately spread the suggestion that it was a case of carbonic oxide poisoning, which certainly was ridiculous. In these lace factories, they needed very dry heat for economical working; and there was a strong objection to having any ventilation at all. It was most difficult to get a window open, even on a bright summer day. People brought up to the business became acclimatized, more or less, to the putrid atmosphere, and did not mind it. The Directors determined to have the matter sifted to the bottom, and he made tests himself—trying to determine the composition of the atmosphere, both in the daytime and at night, with various forms of low-pressure light, flat-flame burners, and high-pressure lights; and, as far as he could see, it resolved itself mainly into a question of a big increase of carbonic acid. They determined, however, to have a thorough inquiry into it, and asked Mr. J. Atkinson Butterfield to come down and make an exhaustive report. He had it with him, and should be glad to let anybody interested have a copy, as it was very important indeed to those who might have to deal with high-pressure lighting in factories, as it went into the matter most thoroughly. They took samples of the air in six different shops where there were electric glow lamps, flat-flame burners, and high-pressure burners. They also took the number of people in the room and the details of the ventilation. In analyzing gases, Mr. Butterfield went principally on the lines adopted by Dr. Haldane, and published by him in a Blue-Book issued last year on the "Ventilation of Factories and Workshops."* They found out that the whole question was what he suspected—one of ventilation; but the manufacturers would not have the windows opened, and one of them gave up the light. The figures were as follows: In shop No. 1, with electric glow lamps, the ventilation in the day time showed 1620 cubic feet of air per person per hour; and the volume of carbonic acid in 10,000 volumes of air was 8. In the same room at night the ventilation could not be observed, inasmuch as the windows had been left open for about an hour previously; and therefore the result might be incorrect. But the carbonic acid had risen to 9·5. In No. 2, with flat-flame burners, the ventilation per person was 1500 cubic feet; and the carbonic acid 8·4, which rose to 16·8 at night. In No. 3, the ventilation per person was 960 cubic feet; the carbonic acid in the day time was 10·9, and at night 11·1. In another shop, with high-pressure lights, the ventilation was 1900 cubic feet of air per person, the carbonic acid was 7·6 in the daytime and 25·2 at night. In another shop lighted on the high-pressure system, the ventilation was 1255 cubic feet, the carbonic acid in the daytime 10·2, and at night 20·3. The last shop from which he took a sample was a one-story factory, exceedingly well ventilated. They found out that the proportion of carbonic acid gas in the daytime was 7·6, and at night it only went up to 9. So that the whole question resolved itself into one of ventilation. The Committee of the Board of Trade recommended certain limits of carbonic acid which should not be exceeded; and if these recommendations were kept to, they would have a reasonable chance of getting this business. But they had to face the fact that they had either to get ventilation by fans or to take away the products of combustion by means of tubing. At any rate, this was an important matter for those to attend to who might have to put up high-pressure lighting in factories. Then they had difficulties with the Insurance Companies. He wrote to them and told them about the incandescent light, and had a host of surveyors down in a very short time. He was astonished to find that, without a single exception, they had never heard of a high-pressure light—the very name seemed to startle them. They had the idea that they were working at something like 100 lbs. pressure. In textile factories, they had certain limits for the incandescent light, and restricted the use of flexible tubing to 18 inches in length. In their case, they had 2 ft. 6 in. tubes, in order to lessen the vibration. He tried to point out that there was no more danger in having a 2 ft. 6 in. tube than one of 1 ft. 6 in.; but they said the regulations were laid down by the Tariff Committee, and it could not be allowed. Therefore they had to cut down the length of the tubing. He suggested to them that in all probability some representation might be

* See "Journal," Vol. LXXX., pp. 1266, 1398, 1682.

made from some authority as to this question of high-pressure lighting; and he thought the Institution should take the matter up. In the lace factories of Long Eaton, they had decreased the risk by 20 per cent. Yet they were not disposed to allow them to do anything except on sufferance; and no matter what representations were made, they did not take much notice. With regard to the number of mantles, they adopted several forms of springs—including one used in the lace machines themselves; and that really made the lamps quite flexible without any deterioration of the mantles. The up-keep would be about one mantle per month per burner; but it was necessary to have them inspected every week. They provided the mantles free of cost, and let the high-pressure burners on the hire purchase system. Their own men kept them in good condition, charging the mere cost. He should be very glad if they could get some method of doing away with the vitiation of the atmosphere; for unless this was done, he was afraid they would have to go back to the old flat-flame burners.

Mr. W. Grafton (Beckton) said he should like to make a few remarks on Mr. Marshall's paper, especially as he had referred to him and his work very extensively. Many of the members might have visited Horseferry Road (if not, they ought to do so), to see the magnificent display there given. It brought out distinctly in every detail what he stated in his paper two years ago—that adding air was a distinct advantage, in spite of the fact that he got slated for "adulterating the gas." Of course, it was not adulteration of the gas, as had been pointed out; it was a question of aerating it. One got far better economy from it in every sense of the word—more light and less gas. His own figures gave from 45 to 55 per cent. decrease in the gas consumed; but Mr. Marshall's were still more favourable, because he was able to operate under better conditions. The experiments he (Mr. Grafton) made were with small holders; and naturally one could not get such good results as with the gas constantly flowing. Mr. Marshall, when referring to the heating values of different gases, said there was no reason why gas of more than 10-candle power need be supplied, provided a desirable calorific value were present. It seemed to him that the calorific value was not wanted for the incandescent light at all. Carburetted water gas, or air, reduced the size of the flame, and brought it within the scope of the mantle. The mantle should be so put on the burner that the flame just touched the fringe of it. Then only did they get the maximum efficiency out of the mantle. Besides this, the life of the mantle was much longer when it was so burnt than when, for instance (as in the Kern burner), they had about one-third the incandescence at the base of the burner of that at the top. When it was uniformly heated, it expanded and contracted regularly; and they did not get that breaking or splitting up of the mantle, which was so destructive. He did not notice in Mr. Marshall's paper any statement as to the life of the mantle on the low-pressure system, though he gave it six weeks on the high-pressure, which was rather longer than he anticipated. With regard to the heating value, he said that, with 16-candle gas, it was 140 calories, or 573 B.T.U.; while 11-candle gas gave 115 calories, or 460 B.T.U. He found, however, in the current issue of the "Journal of Gas Lighting" an article in which the calories and British thermal units were not quite in accord with these figures. What he should like to see was that they could say that 14-candle gas was within 10 units of a certain figure—not hundreds. With regard to the efficiency given by Mr. Marshall for his low-pressure burners, he must thank him for being so liberal with his (Mr. Grafton's) paper as to take the lowest figures and not the best. He showed what could be done; and it was certainly desirable, even if it appeared to be against the interest of the gas supplier. But he did not think it was, because it was better to have six gas consumers burning (say) nominally 3 or 4 cubic feet, instead of one burning 50 cubic feet. The one taking 50 cubic feet grumbled because of his excessive gas bill and bad lighting. At the same time they could not do without him. They wanted to please him; and the only way to do so was to give him results that not only affected his pocket, but his eyesight. Mr. Marshall spoke of the "C" burner having a whirling motion, producing a darkening or less illuminating effect on the mantle. He (Mr. Grafton) did not quite understand this, because in the burner there was no whirling action. There was in the Kern burner, no doubt. Coming to Mr. Onslow's paper, he spoke of the burner-jet being thrust higher up the bunsen tube; and with his apparatus he found that the farther it was placed away from the bottom the better. It seemed to him that if Mr. Onslow found a better result from thrusting it farther up, there were two points at which they could get efficient combustion out of the bunsen burner—not necessarily just on a level with the air-inlet. With regard to his other work, he should like to point out that it was very easy to discuss a paper, sometimes adversely; but theories based on practice and experience were better than those based on imagination. For this reason, he should like particularly to express his thanks to Mr. Marshall for the able way in which he had shown that his paper was not founded on theory, but on practice.

Mr. T. S. Lacey (London) said Mr. Goulden had shown how essential it was that the flame of an incandescent burner should fit the mantle, and also how important it was to have a good mantle. A great many mantles would shrink, and then they presented a different surface to the flame and rapidly deteriorated. Good mantles could be made, and some were, and he hoped would continue to be made.

The President then called upon the authors of the papers to reply.

Mr. Sugg said his only object in bringing forward his paper was to show what he had done in the matter; and, with what had been said in the other papers, he thought everything had now been placed before the members which had up to date been done in the matter of incandescent lighting. Nothing had been said with regard to his paper which called for any reply; and therefore he did not propose to take up the time of the meeting.

Mr. Onslow said, with regard to high-pressure lighting, he was very much struck by a paragraph which he saw in a Scotch paper: "What is the definition of an engineer? An engineer is a man who will do for a shilling what another man will require five shillings for." This was his idea of the apparatus referred to in his paper. It was introduced by Colonel Sale and himself with the object that the men in a factory should, under working conditions, have as simple an appliance as possible; and everything was done to obtain this effect. They had sought to reduce the cost as far as possible. The depreciation was low, the first charge was low, and everything was in conformity with it. He might explain that the top valve was an aluminium plate closed under high pressure. [Mr. Onslow exhibited the various sizes of burners in use.] They had had difficulties with the mantles; but they had overcome them to a great extent. The one they employed was very strong. The great difficulty was to get a good mantle in England, and they had at last to go to Germany for it. They had now one which would last for 400 or 500 working hours; and it was thoroughly reliable. It was, in fact, two mantles—one woven on the top of another. It required high pressure to pass the gas through them. For (say) 10-inch pressure, they would employ a single one; but at 20 inches they must have a very thick mantle to compel the gas to force its way through. By this means they got a longer life and much better result, and could go to any intensity desired. He should not hesitate to say he could make a 2000-candle power burner if it were necessary. One gentleman spoke about supervision and technical training. This was one thing in which he took very great interest—the training of young men on purpose that everything should be looked after properly. It was one of the most essential things, in high-pressure lighting especially, to have thoroughly reliable men to see it was carried out in a thoroughly workmanlike manner. There was nothing more annoying than to go past a shop window and see the mantles hanging down, looking quite disreputable. It did more harm to gas lighting than anything. If he went through a building at the end of a month, or six months, he always found the light was well looked after, and there was never a complaint. The next thing they did was to take away all the flat-flame burners, and really flooded the place with light; and they did this at a very low cost. It was possible to see to pick up a pin underneath a table or a machine in any part of the building. The aim was to take the place of daylight after dark; and they could do it at almost daylight price. With regard to Mr. Stevenson's remarks, he was very sorry for him and his difficulties, because the question of carbonic acid was a serious one. The probability was, if he could only get the people to ventilate a little better, there would be no difficulty in the lighting of the buildings. They found no trouble whatever in the buildings where they had been introduced.

They had 1½ million candle power at work in different places—in Government buildings, and in all parts of England—and found no difficulty anywhere. The simple reason was that the Factory Laws came in, and said they must have open windows in the day time; and at night time they had ventilation. Then there was no trouble from a vitiated atmosphere. He was rather sorry there had not been more opposition, because he wanted to be opposed as much as possible, in order to bring out the different points connected with this high-pressure lighting. He thought they all throve better under opposition.

Mr. MARSHALL said he did not think they throve better under opposition. On the contrary, he was sure they did not. He did not quite understand his friend Mr. Carpenter; but he thought he alluded to the extraordinary results they obtained from the Auer burner consuming 3·5 cubic feet of gas per hour.

Mr. CARPENTER said he understood Mr. Marshall to say it was the same burner, in the same mantle, and under the same circumstances; and that led him to think the mantles were particularly inefficient.

Mr. MARSHALL said that only bore out what he said. If Mr. Carpenter would look, he would see that the same burner, with 1½ inches pressure, burning 4·7 cubic feet per hour, gave 22 candles per foot.

Mr. CARPENTER said that was not his point at all. There was a series of figures at 3·5 cubic feet per hour, and the result in candles regulated to 1-inch pressure. These readings varied considerably; and his point was this—that if the method of testing gave such variable results, they should be very careful how they attached any value to the particular system under discussion. The photometer had broken down under the strain of the Auer burner.

Mr. MARSHALL asked which photometer had broken down—the one at Berlin or the one at Copenhagen?

Mr. CARPENTER said he did not know where it was, but the particular photometer used for this test had broken down completely.

Mr. MARSHALL said this was not so. The results showed just what they had been endeavouring to show—that the flame must fit the mantle. When they had the big flame under the 1½-inch pressure, it filled up the mantle, and they obtained fairly good results up to 22 candles per cubic foot. If they muzzled the flame down to 3·5 cubic feet, and kept it there, the result was that it did not fill the mantle, but whirled about inside—producing first a bright spot on one side and then on another; and it was because they muzzled that flame down to 3·5 cubic feet, and put it in an *environ* where it did not fit, that they got these extremely variable results. This went to his point—that the burner was not complete, inasmuch as it permitted the gas and air, in mixing, to whirl and whirl around inside, causing the whirling motion to the gas and the flame.

Mr. CARPENTER thought that if Mr. Marshall had a burner giving irregular results, and giving a bright spot first on one side and then on the other on the disc, he should unhesitatingly have rejected the tests, and put them on one side as not worth the paper on which they were recorded.

Mr. MARSHALL said in that case they would have to throw up the whole of the 5000 or 6000 tests. He gave those results which were obtained by his photometrist, (Herr Wisby) and his Assistants; and he gave them as showing some remarkable variations. He had no doubt if Mr. Carpenter took a burner giving this effective value at 4·7 cubic feet per hour, and muzzled it down to 3·5 cubic feet with the same large mantle, he would get similar results. It was only when they got a mantle to fit the flame that they could hope to obtain a high effective duty from the burner. These tests were made in his laboratory in Copenhagen. The high-power results were obtained in the Berlin laboratory by Berlin officials, and were verified by himself. He could not, in this case, compare what he obtained in Copenhagen by the low-power system with what was obtained in Berlin with the high-power. As far as the high-power duties were concerned, he understood one gentleman to say he thought them remarkably high. Mr. Goulden had tested the high-power burner at the Horseferry Road station, and the results were almost on all-fours with his own. Hitherto the burner had been tested in Berlin with 14-candle gas, and, as he had endeavoured to show, they had got a higher flame-intensity with that quality of gas than could be obtained at the Horseferry Road with 17-candle gas; and the "Selas" apparatus there would not give this effective value until they opened the valve a little more, and had more air to tackle the over-rich gas. But he was hoping that in a few days they would get up to, and even more than, 40 candles per cubic foot of gas. The difference between Mr. Goulden's tests and his own were not appreciable at the present moment. It was only a matter of three or four candles in 1700—a mere matter of detail. In these discussions, they seemed to have approached the question from the high-power side—500, 800, and 1000 candle power; but it seemed to him that the charm of the "Selas" system was not in developing these high flame-intensities. That had been done over and over again. The high-power "Selas" might be a little in advance of other systems or it might not; but the charm of the system, in his opinion, was that it could develop a low power for domestic lighting, or the lighting of small shops and restaurants; and to anyone having an installation of about 20 burners they could give about 40 or 50 per cent. more light by simply rearranging the Auer system. He thought they ought to appeal more to the small and domestic consumers than to users of the high-intensity burners, which he looked upon as simply scientific curiosities, because the heat developed was so enormous; and the difficulty of obtaining a mantle to last more than about 100 hours was so great, that they became really almost unusable for intensified lighting. He considered that, when they got up to 500-candle power, they ought to be satisfied. In the "Selas" system, he had endeavoured to show that they could obtain 30 candles per cubic foot by simply reducing the gas consumption down to 1½ cubic feet per hour in an ordinary burner similar to an Auer, and by the addition of two parts of air to one part of gas; and, in his opinion, this should appeal to gas men far more than the consideration of these huge intensities, which were practically useless in the market. It was somewhat difficult to follow all that Mr. Canning had said; but he believed one remark was that they had not reckoned the depreciation fund in the cost of the "Selas" system. Well, that did not concern the paper; it only concerned the "Selas" Company abroad, because they put the system into houses and maintained it themselves. It became a mere commercial question with the "Selas" Company how much they should write off capital for depreciation. The consumer only had to pay about 5s. for his burner, *plus* 2d. for the new mantles. These went to pieces in the course of the year; so that the deterioration question really did not come into effect as far as the consumer was concerned. Then Mr. Canning had referred to the saving in the gas bill, and told them he could do better. Perhaps he could; but his paper was not to show that anything could not be done better, but merely to show that an improvement had been effected on anything that had been done before. Mr. Canning had to compete with electricity; but the "Selas" people did not consider that electricity was in the market at all. When the Auer burner came in, electricity departed; and when the "Selas" system came in, the Auer departed. The paper was only intended to show what the saving was on the "Selas" *versus* the Auer system. If he had attempted to show what the saving was on the "Selas" system *versus* electricity, it would have become simply ridiculous. As to Mr. West's inquiry whether English or German coal was being used, all the tests in Copenhagen were made with English coal, and those in Berlin with German coal. The difference between the English coal and the Saarbrück coal was, however, very slight; the German coal being perhaps a trifle lower in illuminating power. But, as he had endeavoured to point out, this difference in illuminating power played no part whatever, or a very little part, in the high intensity developed by the mixture of air and gas; so that whether the tests were made with English or with German coal was really not worth any consideration. As to the question of mantles, he must say he thought the foreign mantles were better; and they were endeavouring to ship to England as many foreign mantles as they could, so that in a short time they would be able to get as good a mantle in this country as they could abroad. Mr. Goulden had raised a very important question in saying that the flame must fit the mantle. There was another question—that the mantles must be protected from damp, as they had found by experiment that some of the falling off in the results obtained was due to the mantles being taken out of the packages and left about before burning off. The mantle was a very hygroscopic substance; and if one were left in a cellar for 24 hours, it would be found to become clammy and almost wet. This

question of the hygroscopic condition of mantles played a great part in their maintenance. In some of their towns they had started to do away with the flash-lights, because they thought they were using too much gas; and they sent a man round to light up the burners in the evening—hoping, of course, to recoup themselves from the flash-light. But the mantles required renewing a far greater number of times in the course of the year without the light. It was found that keeping the mantles warm the whole day and night enhanced their value from 20 to 30 per cent. In making these tests, he was sure they had none of them paid sufficient attention to securing that the mantles should be properly dry before burning them off. He thought it would be found at the Horseferry Road that if they only kept their mantles dry, the effect would be to increase the photometric results. As to Mr. Stevenson's little disquisition upon ventilation, he (Mr. Marshall) had not touched upon this subject in his paper, because it seemed to be self-evident. Here, again, he was not speaking of the high-power burners, but of the domestic or low-power ones. When they reduced the gas consumption in the Auer burner from 4 to 1½ cubic feet per hour, it followed that the ventilation of rooms must be infinitely better. In the case of a restaurant keeper in Copenhagen, one of the great points he made in allowing people to see the installation was that it was now possible to sit in his *café* in comfort in the evening, and breathe with absolute freedom, whereas with a like number of Auer burners burning 4 cubic feet an hour the atmosphere became intolerable after eleven o'clock; and therefore the admixture of two parts of air and one of gas reducing the consumption could not but be a great step in the direction of proper ventilation. At the Schleber factory at Greïz, before the introduction of the "Selas" system, there was great trouble in ventilating the loom-rooms, where there were perhaps 2000 or 3000 women; but since they had taken to mixing air with the gas the atmosphere was infinitely better. Mr. Grafton had dealt with the question of flame-intensity. Calorific value had nothing to do with flame-intensity; but if they were to have the excellent result from the mantles which they hoped to obtain, they must get the mantle to fit the flame or the flame to fit the mantle. Mr. Grafton asked whether there was any difference in the life of a mantle which the flame did not fit. It had been ascertained, by a long series of experiments, that with the "Selas" flame, which they maintained did theoretically fit the mantle, the mantle lasted 10 per cent. longer, for the reason that the flame fitting closely all round did not present spaces which could be cooled, thereby allowing the threads to contract. The flame of the "Selas" being a perfectly blue flame, there was no trouble as to it firing-back at any time, and no question, through irregularity of the air supply, of a sooty deposit on the mantles, which was so often seen in the case of the Auer burner. It was this sooty deposit in the first place, coupled with the fact that the Auer flame did not fit the mantle, that caused the deterioration and the lesser life of the Welsbach as compared with the "Selas" mantle. The question as to the life of high-power mantles was one that could not be absolutely answered. One day they had a mantle lasting 200 burning hours, whereas a similar mantle might blow to pieces after 20 minutes. The question of the life of the mantle with the high-intensity flame was one to which they must devote no end of attention. There was no mantle in the market which was durable with "Selas" high powers of 2000 candles.

Mr. GRAFTON said Mr. Marshall had not answered his question as to the life of the mantle on the high-pressure as compared with the low-pressure system.

Mr. MARSHALL said that on the low-pressure system they lasted almost a year. They reckoned to replace three mantles in a restaurant in the course of twelve months; but in the Thiergarten in Berlin, with the high-power system, if a mantle went 100 hours it was as much as it would do. There was no question that the life of a low-pressure "Selas" mantle was as long as that of any mantle that had yet been made; but the life of the high-power mantle was a matter of almost absolute indefiniteness.

Mr. GRAFTON said this was what he wanted to know, because he had a mantle of his own which had been in use for a twelvemonth on that system working with 5 inches of pressure.

Mr. MARSHALL said the life of the mantle must depend upon the pressure. If used with a blowpipe all day long, the mantle must suffer. With 15-10ths or 20-10ths pressure, it would last much longer, supposing the flame fitted it in a proper manner. It was a question of calories; and the calories given, converted into British thermal units, were the result of many years' experience. He had not seen the article published in the "JOURNAL OF GAS LIGHTING." They must still go on working to reduce these things to a reliable standard, as abroad they reckoned by calories, but in England by thermal units. Until they had some reliable standard, they would never know where they were; and, if he might offer a suggestion, one of the things the Institution ought to do was to try to get some standard of calorific value. He thanked the members very much for having listened to a paper of foreign importation. The subject was very interesting. If they would only go to the offices of the Gaslight and Coke Company, they would be able themselves to make experiments; and he was sure Mr. Goulden would assist them in doing so. All he wished them to do was to verify what had been done. The results obtained abroad they had tabulated and would stick to; and it would be a pleasure to him to hear, in the course of a few weeks, what they found with the instruments placed at their disposal in London.

ESSAYS AND REVIEWS.

THE GAS AND WATER STOCK MARKET.

(For Stock and Share List, see page 815.)

THERE was no improvement in the general position of things on the Stock Exchange, but rather the reverse, especially for two or three parties, who found themselves unable to stand against the ebb tide. The two evil influences were in the American and the Kaffir Markets, particularly the former, which had a most depressing effect, and produced a degree of timidity and apprehension that almost paralyzed business. Happily the worst point was reached before the close; and a better tendency marked the last days of the week. The fortnightly settlement proved insuperable to two more operators, and must have been a tough job to some more. Money was in good demand; but the supply was abundant. Rates were not stiff, and the tendency at the close was to greater ease. In the Gas Market, there was certainly more activity than in the preceding week; but that is not saying very much, and the aggregate of transactions was certainly not up to what might fairly be expected. There seems for some reason or other to be little demand for gas issues in the Stock Exchange, although at the Mart considerable parcels find ready buyers. The homely investor appears to have a decided predilection for the Mart, where he can buy for himself as a principal, especially when shares in his own local undertaking are on offer. There were very few changes in quotations last week beyond some *ex div.* adjustments; but they were mostly in the upward direction. In fact, Gaslight and Coke ordinary was the only exception; it receded a point. Opening at 86¼, it gradually shrank to 84¾; but the closing mark was 85¼. The secured issues were not very strong; but they avoided a fall. Transactions in South Metropolitan were very moderate; and they gave no indication of approaching change. There were a few dealings in Commercials at unchanged figures. In the Suburban and Provincial group, there was little to attract attention. British scored an advance; but there were no dealings in it. The Continental Companies continued to show firmness; Imperial changing hands at good figures, and Union having a point's advantage *ex div.* Tuscan debentures had a smart rise. There was nothing in connection with the undertakings in the remoter world to call for notice. In the Water Companies, business was again active and interesting, Southwark being chiefly conspicuous; but variations in price moved irregularly. Grand Junction had a smart rise, and East London a small one; but other changes were in the downward direction.

The daily operations were: Gas was busiest on Monday; but prices stood fast. In Water, Grand Junction rose 1½, and East London 1; but West Middlesex fell 2½. Tuesday was very quiet. Tuscan debentures rose 5. Wednesday was quite dull; and Gaslight ordinary fell 1. Thursday was quiet. Many Gas and Water issues were quoted *ex div.*, most of the latter being at a disadvantage. On Friday, the only change was a rise of ½ in British. Saturday was quiet and unchanged.

A large gas-engine plant is to be built for the Velardena Mining and Smelting Company of Velardena, Durango, Mexico. It will comprise gas-engines aggregating 2000-horse power, operating from a central station an ore-concentrating mill, pumps, and hoists at six of the Company's mines, located within a radius of ten miles.

THE PRESENT AND FUTURE OF THE HASTINGS GAS-WORKS.

[Fourth and Last Article.]

So far in dealing with the new works at the Glyne Gap, we have been describing buildings and plant that are actually completed, well in hand, or about to be commenced. The heavy work occasioned by the construction of the railway sidings, the retort-house, and all the interesting work connected with the coal-stores and water-tanks, and the reception, transmission, and despatch of material, have received attention; and now the contributory plant and buildings, which are not *in esse* but only on drawings and in specifications, are to be generally described. It is a big undertaking; but the work is not by any means being hurried. The Engineers are favoured by the time at their disposal; and the Company have been and are doing, without the intervention of contractors, a large part in the raising of the new works. Those parts of the works that must of necessity be let out to contract, and be undertaken by specialists, are being put in hand section by section. In this way, there is not an excessively large number of men on the ground at one time; and more precise supervision can be given than when several dissimilar operations are proceeding simultaneously.

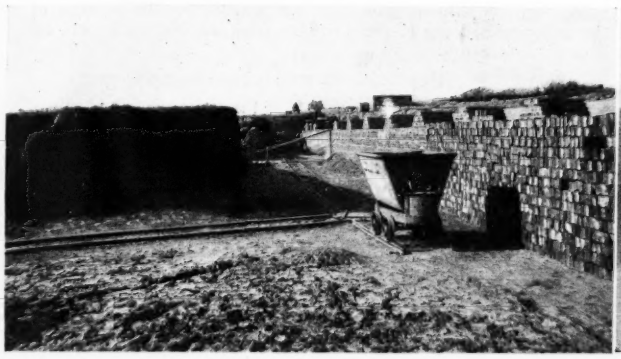


Fig. 14.—Taken on the 27 Feet Line in the Purifying Area.

(The Depth of Earth which was being Excavated will be Noted.)

Fig. 15.—Another View in the Purifying Area.

(The Foundations for the Side Wall for carrying the Purifiers is seen, as well as the Concrete Foundation for the Boundary Wall.)

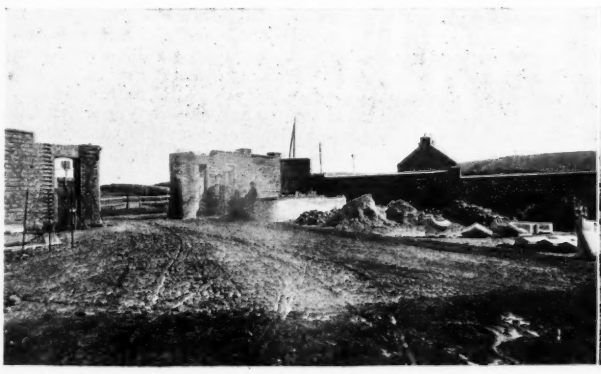


Fig 16.—Inside the Main Entrance.

(This is the Site for the Various Offices. When the Photograph was taken, the Inquiry and Pay Offices, &c., on the right, had just been commenced.)

Fig. 17.—An Excellent Type of Boundary Wall.

(The Wall had to be Built in Lines and Stepped to meet the Curve and Gradient of the Road. The Coping is only Temporary; and the Pointing has yet to be done.)

The Condensers.

However, it is with the plant which will shortly be taken in hand, and which is external to the work of carbonization, that we have now to deal; and once more we go back to the west end of the retort-house to the space which is to be partly covered with a bridge flooring to give passage from one retort-house to the others, and access to the stokers' lobbies. It is here, in the centre of this space, that the condensers will be located. These will be of the water-tube type—a convenient supply of water being available for them in the overhead tanks in the coal-stores. The condensers will stand upon a cast-iron tar and liquor tank, which will extend from the yard-level to the stage-floor line—a height of 9 ft. 6 in. This tank has had to be provided, because, as the condensers will be located at the lowest portion of the site, it would otherwise be necessary to pump the tar away; whereas now a sufficient head can be obtained to deliver it up to the power-house, which has yet to be described. However, the condenser will be available for either No. 1 or No. 2 house; and it will be in two 1 million sections. It is intended, as far as possible, to always work this No. 1 section to its full capacity; and therefore there is to be from this point a 24-inch main running to the machinery section. This will be laid in a trench or culvert which will accommodate all other pipes, cables, &c., and so render the pipes readily accessible.

Concentrating the Machinery.

Before going farther afield, it will be better to describe the power-house, which is a collective title conveniently embracing the boiler and machinery sections. This house is situated in a central position opposite, and as near as possible to—allowing room for extensions—No. 2 retort-house. Here it is equi-distant practically from all points. No steam distribution will take place from it, as all power outside the machinery house will be other than steam.

The boiler-house portion is divided into two parts—a Lancashire boiler section (with boilers 30 feet long by 8 ft. 6 in. diameter, having a working pressure of 160 lbs. to the square inch, and fitted to utilize poor fuel to the best advantage) for ordinary use; and a water-tube boiler section. The latter will not be put in hand in the first instance, but it is necessary when carburetted water-gas plant or the like is installed to meet the sudden calls for gas. We may turn for a moment here from the descriptive narrative. Chatting on this subject of the rapid mutability of gas demand, the Engineer-in-Charge made the remark that it seemed to him that the calls upon gas suppliers were becoming more and more pronounced as regards seasons; and instead of having a peak daily now as the electrical people have, gas suppliers are getting round to a peak of seasons. To meet such emergencies as cold weather setting in, there was, Mr. Botley added, no question that water-gas plant, with water-tube boilers, was the best preparation that one could have. As an

instance, and by way of emphasis, the Chief Engineer stated that last December there was in Hastings a large and sudden demand for gas, which they could not possibly have met without the water-gas plant; and one night, in fact, but for its aid, they would have been absolutely cleared out of gas.

To proceed. Between the two boiler sections, and purposely so built as to isolate each section in the case of an explosion, will be a pump-room and a room for the foreman of the Lancashire boiler section, as well as a large tank of perhaps 70,000 or 80,000 gallons capacity for the boiler feed. This water may possibly have to be purchased, as that so far found on the site is not very satisfactory for boiler use. In addition, provision has been made for induced draught, superheaters, economizers, water-softening plant, condensing plant, and the like. The chimney will be built on similar lines as, but rather larger than, the one at the old works, which was also constructed by Mr. Botley. It will be octagonal in shape, 125 feet in height, and 7 feet in diameter at the base.

To the north of the boilers, and with an intervening space of 10 feet—purposely left again to minimize the effects of explosion, should such unfortunately happen, will be the machinery house. This will be a two storey building. On the overhead floor will be a canteen, a workmen's recreation room, a dining-room, and a shop for light repairs. On the ground floor where the machinery will be, the building is 28 feet wide, and eventually will be 120 feet or more long. It will not, however, be built this length in the first instance. It is to be divided longitudinally into two parts, and each part or side will be served with an overhead crane running on rails. The plant will be disposed in this wise, commencing at the Hastings end: The exhausters for the three sections (each exhauster being a pair of 60,000 cubic feet per hour capacity, driven by one engine); air-compressing machinery; gas-driven electrical plant; and a gas or steam engine for furnishing the power for the shafting in the building and in the vicinity. The floor of the room will be brought up some 3 feet above the outside so as to give access to the pipes, &c., below. The exhaust-pipes will go out southwards (into an alley between the boiler-house and the machinery-house), below the level of the floor, to the condensing plant; and the condensed water will be used for purposes other than steam raising. Similarly, the main steam-pipe will be in the alley, and only branches conveyed direct through to the various engines—the steam main being arranged in such a way as to feed most points in two directions. Super-heating will be resorted to—probably to such a degree as will keep the steam dry, and make up for the slight loss which ensues owing to the introduction of the alley. Otherwise the modern practice of electric-light stations has been followed. Sufficient steam-plant, it is assumed, has had to be provided for to take all the steam which can be raised by the poor fuel, which, if sold, would be of small value.

Beyond this, all the power will no doubt be produced at the outset by gas-driven plant. It is, in fact, intended to have a fuel-gas system throughout the works. Fuel gas can now be produced on gas-works at the greatest possible advantage; and this (says Mr. Botley) in the case of Hastings offers some very considerable benefits. The plan will be developed as circumstances require; and, in but few instances, will illuminating gas be used for power, lighting, heating, or cooking purposes, though, of course, it will always be available should emergency arise. Outside the power-house, where gas-engines can conveniently be used, they will be installed in preference to steam; but in cases where, from circumstances of space, speed, capital outlay, or other special conditions, it will be found more advantageous to employ electric motors, they will be brought into use. Although not absolutely decided, it is probable that the coal breakers and elevators and the coke-breakers will be electrically driven. The motors which are proposed to be installed are, as far as possible, uniform in size, so as to minimize the number of spare parts and the question of breakdowns.

The Purification Plant.

From the exhausters—following the projected plan—the gas continues on its way, without passing back or across the other sections, which is an important point, and by the shortest route, through a Pelouze and Audouin tar-extractor, and onwards through the scrubbers, washers, or scrubber-washers; provision being also made for cyanogen recovery, naphthalene extraction, &c. From this group of plant, the gas will pass across to the purifiers proper. The design for these is now in hand; and possibly for the first section, if the requirements can be fulfilled, a closed type of lid will be used. The objection to the Green system, in the opinion of Mr. Botley and his Chief Assistant, is the apron piece that extends all the way round. It is a *sine quâ non* that that should come off in one or two pieces, leaving the box quite as clear as in the water-luted type.

The purifiers will be arranged in the completed scheme in two lines—No. 1 section being the farthest point in the north-east; No. 2 being to the south of these; No. 3 being in the same line as No. 1; and No 4, for dealing with the carburetted water gas, being in the same line as No. 2. (Figs. 14 and 15.) The purifiers, which will be arranged in a set of six or seven, and continuous, will be of cast iron, with planed joints, and carried on a steel superstructure—giving access to the underside of the boxes, and leaving the valves and connections all free and readily approachable. The main pipes only will be sunk just below the yard level, so as not to cause any obstruction. It was not considered desirable to raise these boxes so high as to get a truck under the boxes themselves but bottom emptying doors are to be provided, which will enable the contents to be removed either in conveyors or trams. Side emptying doors have also been arranged for; and these will enable ordinary railway trucks to be brought alongside on the centre floor, to receive the purifier contents. In the case of the oxide, this will, of course, be thrown out on to the floor in the centre for revivification. Lifts, with turn-tables, will be provided at the end of the centre floor, so that when lime arrives it can be emptied on to the floor, and slaked immediately opposite the next purifier to be changed. From the overhead centre floor, it can be barrowed and tipped direct into the boxes—the centre floor being level with the top flanges of the purifiers. As in Mr. Botley's experience it is found impossible to spread lime in the proper consistency in purifiers with any automatic machinery, he prefers, and considers it the most satisfactory plan, to barrow it in. The purifiers are to be 32 ft. by 40 ft., and will be continuous, being merely provided with division-plates.

Generally described, the design for the purifying-house is a building with a centre floor, and revivifying-floor under it available for either line of purifiers. A plain roof, with a louvre in the centre, will cover the boxes; and the building will abut on to the front boundary wall. An overhead crane will be provided, driven electrically, and started from the verticals which carry the roof. It may be mentioned that, for the subsequent sections of the new works, some of the purifiers from the old works will be brought into use.

From Glyne to Hastings.

It was stated in the first article that the old works at Hastings would continue to serve as a storage station; and at the outset there will be no holders at Glyne. In view of this, a trunk main, 24 and 30 inches in diameter, has already been laid between Glyne and the Hastings works—a distance of about 4 miles. At the latter works, a pair of 80,000 cubic feet exhausters, which form part of the existing plant, will be utilized for drawing the gas from Glyne, where a temporary meter will be installed for registering it before its departure. The exhausters installed at Glyne will pump through the purifiers into the trunk main; and by drawing at the Hastings end, it is hoped there will be a sufficient draught to prevent any excessive back-pressure. In case, however, it is found necessary to relieve the back-pressure at Glyne, Sturtevant fans, combined with gas-engines, will be used to force the gas to Hastings, in addition to the drawing or vacuum exhausters. The big main will contain 250,000 cubic feet of gas under ordinary conditions; and at the present time it is being kept pumped up under air to about 130 inches of water, or 5 lbs. per square inch. This main ought certainly to suffice for any reasonable prospective increase.

The foregoing is the present method of working; but later on, the gas will pass from the purifiers at Glyne westwards, to meters which, with the valve-room, will be combined between three projected holders of a capacity of about $2\frac{1}{2}$ to 3 million cubic feet each, which will be situated at the north-west corner of the site, as shown by the plan published in the "Journal" for the 2nd inst. The Glyne holders will be of the partial framed type which has been used with great success at Hastings; and the approximate dimensions will be 170 feet diameter by 120 feet high.

Administrative Offices, Stores, and Laboratory.

There are a few miscellaneous features about the Glyne works still to be noticed: and we will take them in the order in which they come to mind. First, mention may be made of the administrative offices, which will be at the main entrance of the Glyne works in the Hastings Road. (Fig. 16.) These offices (the head offices will, of course, remain as at present at Hastings) will be combined with the boundary wall, which has been built in such a way and of such a thickness as to permit of this combination. The boundary wall is an excellent and tasteful piece of work, is built of ordinary bricks, with panels on the exterior surface, but perfectly plain on the inner side. (Fig. 17.) It extends from the entrance to the works to the end of the purifier area, and has been stepped so as to meet the curve and gradient of the road. The entrance to the works will be in the form of an elliptical archway; and from this there will be a straight main thoroughfare right through the works, some 60 feet wide. The road will serve for the pipe culverts from one point to another; it being proposed that all the pipes on the works shall be culverted. On the left-hand side of the entrance will be the gatekeeper's and time and inquiry offices, together with the waiting-room and pay offices. Adjacent to these, the time-keeper will have a strong room, ambulance-room, key-room, and fire extinction plant—all conveniently situated and under his immediate supervision. Telephones will be installed in the same office. At the rear will be the lavatories, and a staircase leading to the overhead floor. Farther along towards the lift-house will be the stores, built in two storeys; and, in the first instance at all events, there will be situated here the blacksmiths and carpenters' shops, &c. Farther along, will be the stables, with loft and stores. Next to these, but in a very convenient and out-of-the-way position, will be the men's closets and urinals. These will be constructed in rather an elaborate way, as it is the hope that, with the provision of high-class accommodation, the men will be educated up to the great advantages to themselves of proper sanitation and cleanliness.

On the right-hand side of the main entrance, there is to be a bicycle room, office and weighbridge for the road traffic, and the cash office. On the second storey, there will be very convenient accommodation for the superintendent, the engineering staff, drawing-office, the clerical staff, &c. Farther north inside the Hastings Road boundary wall, space is reserved for considerable extension in the way of office accommodation or workshops.

The laboratory will be on an elaborate scale; and it will be placed between the purifiers and the machinery-house, which is a central position readily accessible to and from all sections. A photometer room, and a dark room for photography are included in the plans, which disclose a very liberal recognition of the benefits of an up-to-date laboratory.

Carburetted Water-Gas Plant and Chemical-Works.

The scheme embraces provision for carburetted water-gas plant; but the details have not yet been completed. When it is installed, Mr. Botley promises that it shall contain some noteworthy features. The plant now existing at Hastings will later on be transferred to the new site. The plans for the chemical-works are also in an embryo state. The site, however, has been fixed; and the extent foretells of the plant being on a very comprehensive scale.

Studying the Amenities of the Locality.

It is quite manifest that the Company are doing their utmost not to retard by their operations the development of the immediate neighbourhood, and to maintain to the utmost its amenities for future residents. On the one hand, we have seen that along the Hastings Road, they have erected a boundary wall which is by no means an eyesore from an architectural point of view; and, on the higher part of the site, which is bounded by the De la Warr Road, they are going to build houses which will provide good accommodation for the workmen employed, and of a class that can be let on advantageous terms. To avoid any unpleasantness to the houses which may be erected on the estate on the opposite side of the road, it has been determined to erect flats, or houses in blocks of six or eight, with a pleasing villa elevation, and a garden 10 feet wide in front, which the Company are contemplating to maintain themselves with suitable trees. The plans reveal a completeness in the provision of all modern conveniences. The Company and their Engineer and his Chief Assistant must be complimented upon the studied manner in which they have schemed and planned in order to minimize to the utmost the objections which their future neighbours may entertain in regard to gas-works.

In Conclusion.

We have come to the end of the mass of notes made on the day spent in the company of Mr. C. E. Botley and Mr. C. F. Botley, at the old and the new works. For their attention and the fulness of the information imparted on that occasion our thanks are due. The construction of the new works is now reaching an interesting stage; and, although, as will have been observed, the type of the whole of the plant has not yet been finally determined, a point has been reached at which we have been enabled to give our readers the main features of this highly interesting new gas-works scheme. There will without doubt come a day, after the first section of the works is completed (it is expected that it will be in operation next year), when a body of gas engineers will have an opportunity of inspecting and pronouncing judgment on them; and then that judgment, it may confidently be said, will be a confirmation of the opinion formed on our recent inspection, that the Engineer has dealt with the circumstances of the site in the most advantageous manner, that the works themselves, while complete in every department, have been constructed with judicious economy in capital expenditure, and that in their character and arrangement care has been especially exercised to the end that, as the scheme expands towards consummation, progressive working economy will be realized. The buildings and plant so far constructed and the plans show an independence, breadth of view, and originality which will invest the finished works with more than passing interest. Their size, too—beginning with a 2 million cubic feet coal-gas section, and ending with two more sections of equal productive capacity, and a carburetted water-gas plant, making four sections in all—brings them within the comparable range of a large number of works in the country. For these reasons, we believe the publication of this short series of descriptive articles, with the plans and photographs, will not only be of interest, but of value, to engineering readers.

We are sorry to learn, from the last issue of the "American Gaslight Journal" to hand, that, in consequence of the state of his health, General Hickenlooper has tendered his resignation of the presidency of the Cincinnati Gas and Electric Company. In the letter containing the announcement, he expressed the wish and hope that Mr. Norman G. Kenan, the Vice-President of the Company, would be named to succeed him. The General will retain his place on the Board of Directors. He has been connected with the supply of artificial light in the city for upwards of forty years, and was chosen Vice-President of the Cincinnati Gaslight and Coke Company in 1873, and elected President in 1877. When the gas and electric lighting interests were united in the Cincinnati Gas and Electric Company, he was placed at the head of the concern.

TECHNICAL RECORD.

THE SETTLE-PADFIELD CARBONIZING PROCESS.

A Vertical Retort Arrangement.

In last week's "Journal" (p. 667) some prominence was given to an arrangement of vertical retort—the invention of Dr. Bueb, of Dessau—of which good things are just now being spoken in Germany. To-day we are enabled to give a description of a carbonizing process, the subject of an English patent taken out in June last year by Mr. Thomas Settle and Mr. W. A. Padfield; the former gentleman being Assistant to the latter in his capacity of Engineer and Manager of the Exeter Gas Company. In the same manner as last week, it is intended to-day to let the patentees describe their proposal practically in the words of the patent specification; and later on we may have some further details to give of the results arrived at in the actual working of the retorts at Exeter during the past few months.

The patentees remark: In the manufacture of coal gas, it is usual to employ horizontal retorts, into which the full charge of coal to be carbonized is introduced at one time, and forms a long heap or a series of heaps on the floor of the retort. Before charging, it is necessary to discharge the coke produced in the retort by the carbonization of the coal; and for the purpose of charging and discharging, the cover is removed, leaving the retort open to the entrance of atmospheric air. As these two operations occupy some time, a cooling-down of the retorts takes place, which has to be made up for when the cover is again closed. Besides, during this time a smaller quantity of gas is produced than when the full heat is maintained, with an increase in the quantity of tar, as low heats are likely to distil over a larger proportion of the tar than high heats.

To overcome this inconvenience of the cooling-down of the retorts during discharging and charging, the use of inclined retorts has been proposed. As, however, the discharge of these retorts takes place from the lower end, and the charging is effected at the upper end, the time that the retorts are required to be open is much reduced, because the inclination of the retorts facilitates the discharge of the coke; while for the charging, the full charge of coal is shot in, in one lot—the incline being such that the charge will readily and automatically distribute itself evenly on the floor of the retort, after which the top cover will be replaced, with very little loss of heat.

In both these cases, the retorts are charged at long intervals—varying from four to eight hours, or even longer, according to circumstances. "This mode of carbonizing coal has been found to be wasteful—resulting in a failure to obtain the full quantity of the gas that the coal is capable of producing, and also to obtain the highest quality gas."

Now by an exhaustive series of experiments, the patentees claim to have proved that to pass a high quality gas over or through red-hot coke, impairs in a marked degree its illuminating value, and, further, when the coal is introduced into the retorts in bulk, it is almost impossible to properly carbonize it all through in the time allowed, as is more fully explained hereafter.

The object, therefore, of this invention (to overcome the disadvantages enumerated) is to simplify the process of carbonizing coal, whereby a considerably increased yield of gas per ton of coal will be obtained, and at the same time the gas produced will have a higher value; and, moreover, a coke of improved quality will be produced and a considerable economy in the amount, quality, and cost of labour will be effected. To this end, the invention consists in (1) the mode of introducing the coal into the retorts, (2) the means to be employed for this purpose, and (3) the mode of arranging or setting the retorts.

A modified vertical retort is employed, and the charge is gradually built up in the retort, which is heated externally in the usual manner. In this way, the coal is said to be completely carbonized, and a gas of a high degree of illuminating power is obtained, because the gases have not to pass over, or in contact with or through, a mass of red-hot coke; and for the same reason, a much better quality of coke is obtained. As an additional advantage, it is possible, if desired, to make use of small or dust coal or slack, which is fed into the retorts gradually or in small quantities at comparatively frequent intervals by appliances which will provide for the sealing of the retorts during the feeding operation.

The illustrations (next page) show in diagrammatic form the inconveniences of the old plan of charging retorts, and how it is proposed to overcome them; "the details of construction being of minor importance, and being capable of variation in many respects."

Figs. 1 and 2 represent in cross section and in longitudinal section a horizontal retort as now used, so as to illustrate the result of charging in bulk. A is the retort of the ordinary D form, and B C represent the charge of coal lying on the floor of the retort. The retort being heated externally, the portions of the charge lying next the walls of the retort become comparatively quickly carbonized, and form a mass of red-hot coke, as represented by B. As in this case the carbonization is effected from

the outside inwards, a core of uncarbonized coal will be left, as represented by C, surrounded by the red-hot mass B. As the core gradually becomes carbonized, the gas driven off has to pass through the mass B, and in so doing, portions of the gas become decomposed and lose their illuminating properties. To such an extent is this so that it does not pay to keep on the carbonization

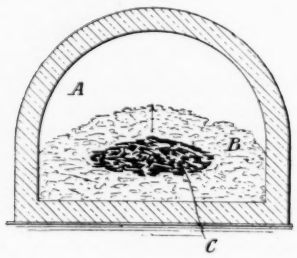
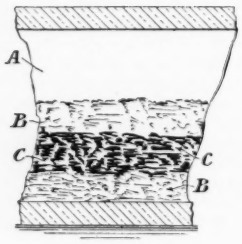


FIG. 1.



G 2

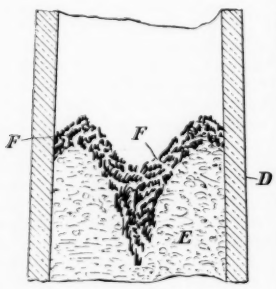


FIG. 3.

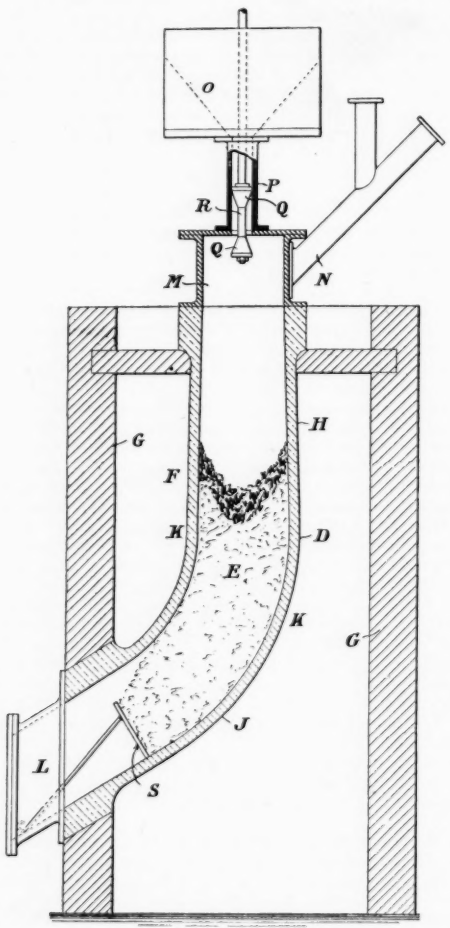


FIG. 4.

until the whole mass is completely carbonized. It results, therefore, that a portion of the core remains uncarbonized, and "thus a loss of gas takes place, while much of the gas driven off is impaired and is of poor quality."

Fig. 3 is a diagram showing, in vertical section, part of a retort, and illustrating the mode of procedure, according to the invention under notice. D is the retort; E, the mass of red-hot coke; and F, the uncarbonized coal. As before stated, the mass is gradually built up in the retort; but the uncarbonized coal is always on the top (as at F), and the gas is driven off direct to the ascension-pipes, without passing through, or in contact with, the red-hot mass of coke. "The gas thus retains all its illuminating properties, and is not impaired by passing through a red-hot mass of coke."

Fig. 4 shows the character of the apparatus proposed to be employed for the purpose of the invention. G represents the retort-setting—of any suitable character. The retort preferably consists of a vertical portion H, at top, of about one-half the length of the retort, and an inclined portion J below, of about one-fourth the length of the retort. The remaining fourth portion K—between the parts H and J—is curved as shown. The vertical portion is slightly taper—expanding downwards; and the inclined portion is of the larger diameter and extends outside the setting, where it is provided with a mouthpiece L, having a cover of suitable construction.

At top, the retort is provided with another mouthpiece M, with which are connected the feeding appliance and the ascension-pipe N, or its equivalent. The feeding appliance consists of a hopper O, provided with a cylindrical extension P, in connection with the mouthpiece M, and is placed preferably centrally over the mouthpiece, as indicated. In the cylinder P is arranged the measuring and sealing device, consisting of a pair of conical plungers or pistons Q, mounted on a rod R at suitable distances apart, and working easily in the cylinder P.

The stroke of the pistons is such that the top one passes out of the cylinder P at the top, to admit of coal from the hopper O passing in between the pistons, and the lower one passes out of the cylinder P at the bottom, to allow of the discharge of coal into the retort. Thus, one plunger Q always remains in the cylinder P, so that the retort is sealed and the passage of gases from the retort through the hopper is prevented. The plungers Q are operated vertically, in any convenient manner, from some motor.

The result of charging in this way is that the coal will be caused to fall towards the walls of the retort and form in effect the cup-shaped pocket of uncarbonized coal, as indicated at F (fig. 3), on the top of the red-hot mass of coke E. This pocket acts as a kind of cauldron, in which the tar, produced by carbonization, is decomposed; the more volatile parts distilling off in the form of gas of high quality, and "thus a great increase in the yield of gas of superior quality will be obtained."

If small coal is used, it cokes rapidly, and produces a superior quality of coke. The discharge is easily effected through the bottom mouthpiece upon removing a plate S, which serves to support the mass of coke clear of the cover until the cover is removed. When the coke is discharged, the plate S is replaced, and the operation of carbonizing goes on as before.

The retorts are not to be allowed to cool down, and "the life of the retort is much longer in consequence." There is also said to be an entire absence of the smoke seen when charging retorts in the ordinary way.

What the patentees claim is: 1. In the manufacture of illuminating gas from coal, the mode of carbonizing coal in vertical retorts, consisting in introducing the coal into the top of the retort in small quantities, at regular short intervals, and so building up gradually a mass of incandescent material, having a continuous layer of coal in the process of carbonization on the top, so that the gas is driven off without coming in contact with, or passing through, the red-hot mass of coke in the retort, whereby from a given sample of coal a greater volume of gas of higher candle power, together with a better quality of coke, is produced. 2. In the manufacture of illuminating gas from coal, the mode of carbonizing coal in vertical retorts, consisting in introducing coal into the retort in such a manner that the coal will fall towards the walls of the retort—thus building up a mass of incandescent material with a cup-shaped layer of uncarbonized coal at the top. 3. In the manufacture of illuminating gas from coal (as claimed in claim 1), the use of a retort of the character shown and described—that is, having a vertical portion of about half the length of the retort with a slight taper downwards, an inclined portion of about one-fourth the length of the retort, and a curved portion connecting the inclined and vertical portions. 4. In the manufacture of illuminating gas from coal, the combination with a vertical retort of a hopper having a cylindrical extension, a vertically reciprocating coal measuring and gas sealing device in the cylinder, so formed as to direct the falling coal outwards towards the walls of the retort.

The "Flicker" Photometer in the Provinces.—We learn that the first of the Simmance-Abady photometers, of the pattern adopted by the Gaslight and Coke Company at the Horseferry Road for testing the "Selas" lamps, is being fixed at Doncaster to the order of Mr. Robert Watson, the Corporation Gas Engineer. The only difference between this instrument and the one at the Horseferry Road is that the Doncaster photometer is completely equipped for ordinary gas testing, and fully certified by the Standards Department of the Board of Trade, while the "Flicker" attachment enables it also to be used for testing incandescent gas and electric lamps of any power.

THE "ROCKET" STREET-LAMP LIGHTER.

Many are the contrivances which have been devised for the lighting of street-lamps containing incandescent mantles. Some of them answer their purpose admirably; but there are others which have weak and objectionable points. The primary object of all these aids for facilitating the lighting of incandescent burners is the preservation of the mantle from injury. Almost

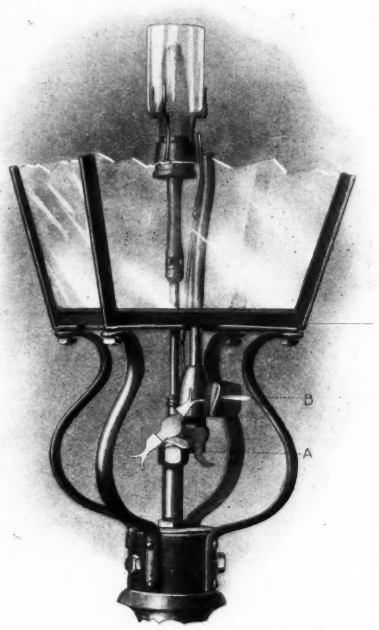


FIG. 1.—THE "ROCKET" LIGHTER.

(The Flash-Jet Tap A Turned on. B is the Shaped Projection in which the Head of the Torch is laid for Igniting the Gas.)

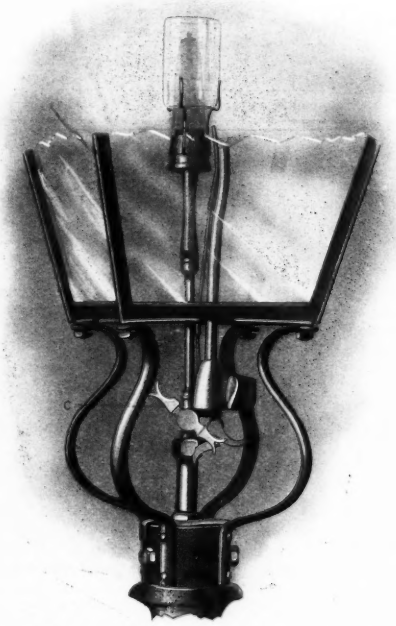


FIG. 2.—THE "ROCKET" LIGHTER.

(The Main Tap C Turned on, the Lever of which Actuates the Lever of the Flash-Jet Tap, and Extinguishes the Flash-Jet.)

at the outset of incandescent lighting came the bye-pass or pilot jet, which was to obviate the necessity for the insertion of the lamplighters' torch inside the lantern. But in this case, the "sparing of the rod" frequently meant the "spoiling" of the mantle; so that the remedy was not much better than the evil. Bye-pass lights require very nice adjustment, or the mantle becomes blackened; and the nice adjustment cannot very well be maintained in street-lamps without tiresome and constant attention. Furthermore, where there are hundreds and perhaps thousands of lamps in a district, the consumption of gas by the bye-pass lights—small as it is per lamp—means in the aggregate an appreciable expense in the course of a year. Then came some new torches—ingenious and otherwise—and new trap-doors for lanterns, all of which had for their object the prevention of the contact of torches in any way with the mantles and their supports. But there are gas engineers who are heard to complain that the jerk caused by the hasty insertion of any form of torch and the slamming of hinged trap-doors are found to assist in the destruction of mantles. These various objections reduced the opportunities for improvement down to a system which should be independent of the constantly burning bye-pass lights, trap-doors, and the insertion of a torch inside the lantern. This produced the climbing light; and now Messrs. Parkinson and W. & B. Cowan are introducing a device which answers the same purpose, has all parts requiring the application of a torch outside the lantern, is a complete fitting adaptable to new or old lamps, is certain in action, and withal is cheap, but cheapness in this case does not spell poor quality, for the whole of the fitting is very strongly made. An ordinary torch is all that is required for its operation.

FIG. 3.

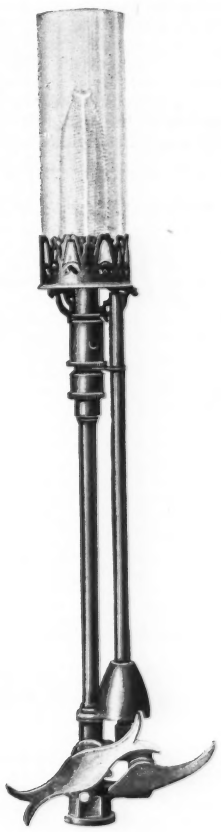


FIG. 4.

SHOWING THE APPLICATION OF THE LIGHTER TO A KERN BURNER (FIG. 3) AND A "C" BURNER (FIG. 4).

This new lighting arrangement has been under trial and undergoing improvement for several months past; and it has been brought to a pitch of perfection at which Messrs. Parkinson and Cowan have full confidence in now calling special attention to it. The principle of this attachment is altogether new. Briefly it consists of the passage into a mixing-tube running up the side of the burner (Kern, "C," or any other form) of a quantity of gas and air, which is ignited below the lantern by means of a torch; the flame being communicated instantaneously to the burner above. If the illustrations are consulted, it will be observed that, at the bottom of the device, there is a double-cock arrangement; the larger cock (which takes the place of the ordinary lamp-cock) forming part of the connection between the lamp service-pipe and the burner. From below and from the upper part of the barrel of this cock two arms protrude; and in a vertical connecting-piece between these is a smaller cock (which for the sake of clearness we will term the flash-jet cock). This is a bye-pass arrangement, serving for the supply of the ignition or mixing tube, through a steatite nipple carried by the upper arm, and covered by a cone, which, in turn, is protected by the coned-end of the ignition-tube, as seen in the illustration. The nipple is pierced so as to throw a fine vertical jet, a lateral jet, and an

ntermediate one. The inner cone is perforated with several air-admission holes, and a larger opening for the passage of the lateral jet. The outer cone is provided with a corresponding side opening, from which cheeks splay, suitably shaped for the ready reception of the torch. Above this outer cone is the mixing-tube running to within 1½ inches of the top of the burner-head. To this tube is attached a small bye-pass tube leading to within ⅛-inch of the burner top, the only object of which is to make assurance doubly sure in the matter of ignition. This describes the whole of the parts of the arrangement, which, though the explanation may not convey it, is, as a matter of fact, very simple.

Let us see now what the lamplighter has to do, and what happens in effecting ignition. The arms of the cocks, it should be explained, are so made that they can be operated by the head of the torch or by a hook on it. The lamplighter first turns on the small flash-jet cock, which allows a supply of gas to ascend into the ignition-tube (air being drawn in at the same time), and a small quantity to pass into the burner-tube. Then the torch is laid in the cheeks of the outer cone, the gas-jets from the nipple are ignited, the vertical one inflames the mixture in the tube, and in a flash the gas issuing from the burner-head in the lantern is lighted. The main cock is then turned on by the lamplighter; and the action of doing this automatically shuts off the flash-jet cock. The lighting is effected promptly; and the lamplighter has no more trouble nor is more of his time required than is absorbed in the lighting by torch of old-fashioned lamps with trap-doors. The flash-jet for the few seconds it is in use is effectually sheltered from high winds; and it is indeed difficult to see where any failure to ignite can arise. The contrivance has been tested by us at Messrs. Parkinson and Cowan's works; and it answered without the slightest hitch on every occasion. It may be fancied that the ignition of the gas and air mixture in the tube would cause an explosion of sufficient force to be detrimental to the mantle; but it is not so. There is really less noise than is experienced in the lighting, from the top of a chimney, of an ordinary "C" burner; so that there need be no fear on that score. Mr. W. North, of Stourbridge, has had about fifty of the lighters in use for about six months; and, he reports, with very satisfactory results.

From the examination made of the "Rocket" lighter, it is safe to say that it has before it a good field of usefulness. There is nothing elaborate about it; it is not unsightly; it is certain in its application; and, we reiterate, it obviates the insertion of anything inside a lantern to contribute to the destruction of mantles.

HEATING VALUE OF MIXTURES OF GASES.

In view of the very prevalent opinion among gas consumers that mixtures of coal gas and carburetted water gas are much more costly for heating purposes than coal gas only, and the absence of any published practical results suitable for its refutation, Mr. J. W. Buckley, Assoc.M.Inst.C.E., the Engineer and Manager of the Falmouth Gas-Works, was led to carry out a series of experiments with the special object of obtaining precise information on the point. Thinking the results may be of interest to our readers, he has forwarded them to us for publication; and they will be found in the accompanying table. He says the experiments were most carefully conducted, and the following conclusions may be drawn from them: (1) With normal pressures, mixtures of the two gases will take longer to do the work, which varies with the percentage of carburetted water gas employed. (2) The question of time may be overcome by increasing the pressure, say one-half. (3) The increased consumption of gas when using the mixtures of the two gases is practically infinitesimal.

Tests of Time and Consumption to Boil Two Quarts of Water in a Common Enamelled Steel "Bachelor's" Kettle, 10½ inches Diameter at Bottom, with 3¼ inch Depth of Water, by Coal Gas, Carburetted Water Gas, and Different Percentages of the Two Gases.

Boiling Burner No. 10 Standard (Fletcher's).								Boiling Burner No. 15 Standard (Fletcher's).							
Gas Used.		Time and Consumption. Pressure of Gas 10-10ths.		Height of Flame above Top of Bars.	Time and Consumption. Pressure of Gas 20-10ths.		Height of Flame above Top of Bars.	Gas Used.		Time and Consumption. Pressure of Gas 10-10ths.		Height of Flame above Top of Bars.	Time and Consumption. Pressure of Gas 20-10ths.		Height of Flame above Top of Bars.
Coal Gas.	C. W. Gas.	Time.	Consumption.		Time.	Consumption.		Coal Gas.	C. W. Gas.	Time.	Consumption.		Time.	Consumption.	
		Min.	Cub. Ft.	In.	Min.	Cub. Ft.	In.			Min.	Cub. Ft.	In.	Min.	Cub. Ft.	In.
All	..	13½	2·30	1½	9¾	2·45	2	All	..	11	2·35	2	8½	2·65	2½
Percentage								Percentage							
90	10	13½	2·30	1	10¼	2·45	1¾	90	10	11½	2·35	1	8¾	2·70	2
80	20	14¼	2·30	1	10½	2·45	1½	80	20	11½	2·35	1	9	2·70	2
75	25	14½	2·30	1	10¾	2·45	1½	75	25	11¾	2·40	1	9	2·70	2
70	30	15¼	2·40	⅞	11	2·50	1½	70	30	11¾	2·42	1	9¼	2·70	1⅞
50	50	15½	2·40	⅞	11¼	2 50	1½	50	50	12¼	2·45	⅞	9¼	2·72	1¾
25	75	15¾	2·40	¾	11½	2·50	1¼	25	75	12½	2·45	⅞	9½	2 72	1½
..	All	16	2·40	½	12½	2·50	1	..	All	13½	2·46	¾	10	2·75	1¼

Note.—The temperature of the water before the experiment was 50° Fahr.; and the water was at sharp boiling on the reading of the time and consumption.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by Correspondents.*]

Gas "Arc" Lamps.

Sir,—After a visit to some of the London show-rooms, and an exhaustive perusal of catalogues, it has become apparent to us that we are at a great disadvantage in our fight with the electric light, inasmuch as we cannot find a small, neat, high-power gas-lamp suitable for outside shop lighting at a moderate price. The electric arc, in its various forms, is, on the whole, smaller and neater; and although we know that gas is far the cheaper illuminant, we are handicapped in our work by the comparatively large size and clumsiness of the gas-lamps. I speak entirely of hanging lamps; there is more range to be found in pillar lamps. The difficulty also shows itself in introducing high-power lamps into shop entrances, show-rooms, &c., in an old town, where the majority of the rooms are very low-pitched. The lamps made are all too large and long.

I should be delighted to hear from any of your readers who can call attention to any lamp suitable. In high-pressure lamps, whether power driven or natural draught, it seems the easiest thing to make a lamp of 400-candle power with a small, neat, semi-opal globe, without risk of injury to the latter when the heat is confined by the inner glass, and all taken upwards. A great business, in my opinion, awaits any manufacturer who will put such a lamp on the market.

A. R. Burch.

Uxbridge, June 6, 1903.

The Retort-House Roof at Hastings.

Sir,—I notice that in your account of the new retort-house at Hastings you describe a novel method of dealing with the covering of the louvre. I can say, however, that a roof exactly similar was erected over a retort-house here in 1879, by the late Mr. George W. Stevenson. There was slate boarding and glass covered louvre. The house is 55 feet wide and about 115 feet long; so it does not in any way compare for size with the one described. But I am under the impression the same idea was adopted elsewhere by Mr. Stevenson on a larger scale. I am sorry to add that, for purposes of giving light, the idea was not a success, and came to rather a tragic end. The house is somewhat exposed; and the wind, one tempestuous night, seemed to have got underneath it. At any rate, next morning it was found that nearly all the glass was broken—some of it hanging down most dangerously. It was replaced by a new one, slated as usual.

F. C. Humphrys.

Ilkeston, June 10, 1903.

Electricity Undertakings and Depreciation.

Sir,—Referring to the article on "The Question of Depreciation" in your issue for the 2nd inst., you must not assume that municipal electricity supply departments do not spend as much in maintenance as gas companies do. They consider it entirely a revenue charge, as distinct from any depreciation; and at the end of any one year the whole of the plant of a well-managed electricity works is kept in perfect repair, so that it is practically as good as new—the total cost of the repairs being charged against the current year's account. This, I take it, is exactly what a well-managed gas undertaking does; and whether it costs more to keep a gas company's plant in perfect repair than that of an electricity undertaking is not the question in dispute. However, if, as I understand you argue, it is the practice of gas companies not only to keep their plant in perfect repair—*i.e.*, retorts, &c.—but, in addition to that, to set aside sums under the same heading, and thus mislead the general public, I am prepared to admit at once that this custom is not practised by electricity undertakings, as any sums set aside over and above that required to keep the works in perfect repair is styled a "reserve," "sinking," or other fund, and not mixed up with figures on repairs and maintenance.

Horace Boot,
Consulting and Resident Engineer,
Tunbridge Wells Electricity Works.

June 6, 1903.

Monazite Sand.

Sir,—With regard to this question, while thanking you for courteously publishing our former note, will you permit us to say that we have received advices from Canada that monazite sand has not yet been found there in important quantities. This is confirmed by official letters received from the chief of the Geological Survey and the Director of Mines whose letters we send. The one uses the word "important" the other "workable," implying at all events that it is there. This from the geological conditions is certain.

Further, we have received authentic information by wire, that a contract has been advertised for with regard to the Brazilian deposits, so that there is some chance that the stir created by the aid of the "JOURNAL," and the powerful assistance of the Principal of the Intelligence Department of the Board of Trade, will bear good fruit—your contemporary, "The Westminster Gazette," notwithstanding. And here we would suggest that it is for the recognized organs of the trade to speak in an authoritative manner on a question of trade policy or technic, and not for a lay paper in an article written, under a sensational heading, by a reporter who, from some of his statements, evidently knows little of the subject he is writing about. For instance, he says that 240 mantles are made from 1 kilo. of thorium; 800 is nearer the mark. However, keeping to the point, we have also received further information as to the Brazil deposits from the Board of Trade, which we also submit to you; but these in the public interest it may be suggested had better not be published at this time. From our own private correspondence, we have intelligence of an exhaustive deposit of monazite in a district as yet unexploited. The particulars of this, for business reasons, must for the moment be withheld. It is free from the vexatious restrictions, duties, and imposts, which are imposed, or about to be imposed, on the Brazilian article.

The particulars of this deposit, we shall be glad to lay before the chiefs of any of the more important gas companies; for, in making our original communication to you, we were, as you were shown at the time, not working in our own, but the public, interest.

We would suggest that the leading gas companies should, as being the largest consumers of mantles in the world, take the matter into their own hands. They have the capital, have in their ranks chemists of repute, and are themselves manufacturing chemists. If half-a-dozen were to form a Syndicate to find a few thousand pounds to purchase a concession or buy land—not necessarily in Brazil, but either there or elsewhere, containing undoubted deposits of monazite—then they could import the sand to this country, refine it in their own factories, and manufacture their own mantles from stockings woven at the present day in Nottingham. Is this an idle dream of the writers, or is it an idea which will commend itself to such master-minds as Sir G. Livesey, Colonel Sir W. T. Makins, Bart., Mr. Bradshaw, and others concerned in this matter in the Provinces.

Our suggestion to the great gas companies is to combine for this purpose, be independent of this, that, or the other make of mantle. Let there be no question of Welsbach this or of German that. The articles they chiefly use are "C" burners, "C" mantles, and ordinary chimneys. These they should combine, and make for themselves; for are they not the largest of all consumers? The middleman's profits should be abolished; and the benefit given to their own customers in cheaper and better materials, and to the shareholders increased dividends. Of course, the companies would pay the Welsbach their royalty.

So far as our information *re* monazite is concerned, or any knowledge we may possess of the mantle industry, will be gladly placed at the disposal of the great companies, with some of whom we propose, in the general interest of the trade, to correspond direct.

London, June 10, 1903. THE NEW EXPORT COMPANY.

[The above letter is now published without comment, for a reason which will be explained at the proper time.—ED. J.G.L.]

Mr. Leicester Greville's Article on Gas Liquor.—Owing to a misapprehension, the corrected proof of Mr. Leicester Greville's article on "Gas Liquor as an Adjunct for the Purification of Water Gas" (*ante*, p. 666) was not returned by him before the "JOURNAL" went to press last week. As a consequence, some errors which he had detected in the figures in the final paragraphs unfortunately crept in. In the 13th line from the end of the article, the amount of carbonic acid absorbed should have been 1·14 (not 1·4) per cent.; six lines lower, 40·8 per cent. should have been 34·4 cubic feet; and at the beginning of the last line but two, the reduction referred to should have been 9 (not 13) per cent. Mr. Greville points out that the error of 1·4 in place of 1·14 affected the subsequent figures.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following further progress has been made with Bills:—

Bills read a second time and committed: Crystal Palace District Gas Bill, Ebbw Vale Water and Improvement Bill, Gaslight and Coke Company Bill, Hampton Court Gas Bill, Leigh Corporation Bill.

Bill reported: Derby Gas Bill.

Bills read the third time and passed: Burgess Hill and St. John' Common Gas Bill, North-Western Electricity and Power Gas Bill, Scarborough Gas Bill, Sittingbourne District Gas Bill, Winchester Water and Gas Bill.

Petitions have been presented against the following Bills: Crystal Palace District Gas Bill, Ebbw Vale Water and Improvement Bill, and the Gas and Water Orders Confirmation Bill (in regard to the Aldershot Gas and Water Order).

HOUSE OF COMMONS.

The following further progress has been made with Bills:—

Lords Bills read a second time and committed: Belfast Water Bill, Scunthorpe Urban District Water Bill, Shepshed Urban District Gas Bill.

Lords Bills reported, with amendments: Harrogate Water Bill, Rickmansworth Gas Bill.

Lords Bill read the third time and passed: Wellington (Salop) Gas Bill.

The Hexham Gas Bill has been referred to a Select Committee, consisting of Mr. George Whiteley (Chairman), Sir Charles Welby Mr. Hugh Law, and Mr. Beresford Melville; to meet to-day.

LEGAL INTELLIGENCE.

THE SUNDAY GAS-TESTING QUESTION.

High Court of Justice, Chancery Division.—Tuesday, June 9.

(*Before Mr. Justice* KEKEWICH.)

London County Council v. South Metropolitan Gas Company.

This was an application by the London County Council for an injunction to restrain the defendants from preventing, obstructing, or hindering their gas examiners from making tests of the quality and illuminating power of the gas on Sundays.

Mr. WARRINGTON, K.C., and Mr. T. T. METHOLD represented the London County Council; and Lord ROBERT CECIL, K.C., and Mr. L. ROSTRON appeared for the Company.

Mr. WARRINGTON, in opening, said the action which came before Mr. Justice Joyce on the 4th of May last* raised the point whether or not, under the Acts regulating the South Metropolitan Gas Company and other Companies, the London County Council were entitled to make their tests for purity and illuminating power on Sundays as well as other days; and the learned Judge determined that it was the duty of the examiners to inspect, and the duty of the Company to allow inspection, on Sundays as well as on other days. After the judgment had been pronounced, notice was given on behalf of the London County Council that the usual daily inspection would be made on Sunday, the 24th of May. This was met by the information that the Company had appealed, and that, as the matter was still *sub judice*, they would not allow the examiners to make their tests. They followed this out by instructing their caretakers at the various testing-stations, when the examiners appeared on Sunday, to refuse them admittance. Under these circumstances, the present motion was launched; and there could be absolutely no answer to it, except that there was an appeal pending against the decision of Mr. Justice Joyce. But no application had been made to the learned Judge at the trial to give any directions as to not making an application in pursuance of the declaration. The matter was of considerable importance to the London County Council and the persons they represented—viz., the consumers—on account of the way in which the testing had to be done. It appeared that if on any particular day the gas was found not to be of the proper purity, no prosecution could be instituted against the Company for that day by itself. It was necessary to take the tests of the day before and the day after, and average between them. Under the judgment of Mr. Justice Joyce, Sunday was one of the days on which a test was to be made; and supposing the gas was not of the standard quality on Monday, a prosecution could not be instituted, because Sunday was the day next preceding and Tuesday was the subsequent day. Unless the Examiners inspected on Sundays, they could not get an average.

His LORDSHIP: You could get an average by inspecting on Monday, Tuesday, and Wednesday.

Mr. WARRINGTON said that was true; but they had to take the offending day, the day before, and the day after. Prior to the date of the judgment of Mr. Justice Joyce, Magistrates had held that Sunday might be omitted, and Saturday, Monday, and Tuesday be taken. But they could not do this now. The inspection would not cause expense to the defendants. All they had to do was to admit the examiners to the testing-stations, or, if they liked, give them a key and let them go in and make their tests. The defendants might want to be present for their own sake; but that was another point. Certainly they need not, if they were conducting their business properly, be put to any expense except that of instructing some one to go round with the officers of the Council when they were making tests. If defendants were producing their gas properly, they need not make any change at all in the present mode of conducting their business. The pendency of the appeal did not of itself suspend the effect of the declaration; and there were additional reasons why the declaration should not be suspended—viz., the difficulty the plaintiffs would have in instituting a prosecution if impurity was discovered either on Saturday or Monday, owing to inspection not having taken place on Sunday. He submitted that defendants were bound to obey the order of the Court.

His LORDSHIP: Do they make gas on Sunday?

Mr. WARRINGTON said he understood they did not.

Lord R. CECIL, for the defendants, asked the Court not to grant any injunction at the present time, having regard to the fact that it was not pressed for at the trial; the plaintiffs knowing that the defendants intended to appeal.

His LORDSHIP said he could not go behind the declaration.

Lord R. CECIL said, with regard to the question of purity, he quite recognized there might be some difficulty; but defendants were ready to meet the plaintiffs in one of two ways. Sunday had always been treated as a *dies non*, and the tribunals had allowed Saturday, Monday,

* See *ante*., p. 384.

and Tuesday to be regarded as three succeeding days; and defendants would be prepared to undertake not to raise any point that they were not. There were two tests—one for purity and one for illuminating power. The testing for purity did not involve additional Sunday labour, as the gas was purified on the Sunday the same as on any other day, by passing through the lime. But testing the illuminating power was a very different matter, as it meant Sunday labour. The defendants were prepared to admit the examiners pending the appeal to test for purity. There was no question, if it was finally decided that the contention of the defendants was wrong, they would have to submit to the tests; but the first question he desired to raise was whether the Court, in the exercise of its discretion, would think it right to grant an injunction at the present time. There was no doubt that there was a substantial dispute between the parties as to a matter of law; it really depended on what was the meaning to be attached to the word "daily" testing in the Act—whether it meant daily in the strict grammatical sense, or whether it was used in the same sense as when applied to a daily paper. The expression was first used in the Act of 1869; but it was not till last summer that anyone suggested it meant Sunday.

His LORDSHIP said it was not right he should be asked to express an opinion upon a point which would shortly come before the Appeal Court.

Lord R. CECIL said he only referred to the point as his learned friend had said there was no answer to the motion. From first to last there had been no suggestion that the public would be injured, or that the gas supplied on Sunday was different to that supplied on week days; and according to the uncontradicted evidence of Sir George Livesey, no testing had ever taken place on Sundays in England. If testing was to be done in future on Sunday, it would involve additional Sunday labour. This had already been found to be the case by the Commercial Gas Company, against whom proceedings had been commenced by the London County Council.

Mr. ROSTRON followed on the same side, and submitted that the Court should, in the exercise of its discretion—having regard to the balance of convenience—suspend the injunction until the appeal had been disposed of.

His LORDSHIP said it was a matter of great regret that the Council could not see their way not to insist on the declaration pending the appeal; but excellent reasons had been given for their refusal. For 33 years Sunday had been regarded as a *dies non*; but since the decision of Mr. Justice Joyce, Sunday had to be counted as coming between Saturday and Monday on any dispute as to testing. It was impossible for him to accede to the argument presented on behalf of the defendants. The fact that Sunday testing might involve Sunday labour was not a matter for him to consider; it was not for him to promote or diminish Sunday labour, but merely to administer the law as it stood. Until the declaration was reversed by another Court, it was binding on him; and as the defendants did not even allege that they could not comply with the order, the injunction, as asked, must be granted, with costs.

Lord R. CECIL said he imagined the injunction would be in the nature of a final judgment; but whether that were so or not, he asked for leave, if necessary, to appeal.

Mr. WARRINGTON said leave was not necessary in such a case.

Supreme Court of Judicature, Court of Appeal.—Wednesday, June 10.

(*Before Lords Justices* VAUGHAN WILLIAMS, ROMER, *and* STIRLING.)

Lord ROBERT CECIL, K.C., in accordance with special leave granted to him on the ground of urgency, moved to-day to stay proceedings upon the injunction granted by Mr. Justice Kekewich. He said he would state quite shortly the grounds on which he asked the Court to grant the application, and then explain how these grounds could be supported. In the first place, he should submit that there was a substantial question to be decided; secondly, that a stay of proceedings upon the terms proposed to the other side could cause no injury to anyone; and, thirdly, that if there was no stay, considerable injury would be caused to his clients, for which there would be no remedy. The defendant Company, which was founded in 1843, had been the subject of a great variety of enactments from time to time; and from 1860 their gas had been tested for purity and illuminating power. In 1869, provision was made for the daily testing of the gas; and this provision was repeated in 1876 and 1880.

Lord Justice VAUGHAN WILLIAMS: You say "daily" does not include Sundays.

Lord R. CECIL said that was his contention. "Daily" was a doubtful word, which was capable of other meanings; but, in the circumstances under which this particular legislation was passed, it did not include Sundays.

Lord Justice STIRLING: That is, you may manufacture and supply gas on Sunday, and you are at liberty to do it without its being ascertained whether it is of the requisite illuminating power or purity.

Lord R. CECIL said that was so; the point being that testing on the other days was a sufficient guarantee of the purity and illuminating power of the gas on Sunday. The construction of the Act for which the Company contended had been repeatedly adopted by Courts of Summary Jurisdiction, who had always treated Saturday, Monday, and Tuesday as succeeding days. At the hearing of the present case before Mr. Justice Joyce (*ante*, p. 384), evidence was given that there had never been any testing on a Sunday throughout the country. On the appeal, the point of jurisdiction would be raised that, under the Act, a Judge of the High Court had no power to entertain such a proceeding.

Lord Justice VAUGHAN WILLIAMS observed that an "injunction" was not a "penalty."

Lord R. CECIL agreed, but said he should contend that where an Act of Parliament imposed upon people a special duty which would not rest upon them but for that Act, and where, by the same Act, or in Acts applying to them, only a special penalty was imposed in respect of a breach of that obligation, that was the only remedy available.

Lord Justice ROMER asked what inconvenience would be caused to the defendants by having Sunday testings, seeing that the men must be at work on that day.

Lord R. CECIL replied that the men were not at work. Since 1872, it had been the practice of the Company not to work the men more than was absolutely necessary after six o'clock on Sunday morning.

Lord Justice ROMER inquired whether there was any objection to the practice which had been in force for the last 34 years being continued until the appeal was heard. As the practice had lasted all that time, surely it might be continued for a few more weeks.

Mr. HUGHES, K.C., who appeared for the County Council, said his clients had a duty cast upon them in the matter; and they felt they were bound to exercise it. Mr. Justice Joyce had made a declaration, and the Council felt they were bound to act upon it.

Lord Justice VAUGHAN WILLIAMS said that might be so; but the Council, from previous experience, knew what was the right course to take in such a case. He remembered a case which came before Mr. Justice Cozens-Hardy, who decided that the Council were acting *ultra vires* in running omnibuses; and it was urged for the Council that, as they had been doing this for some time, no one would be seriously injured by the injunction being suspended until the appeal was heard. The same plea was put forward pending the appeal to the House of Lords; and as the Court acceded to the view then put forward, ought not the Council to recognize that view now? Of course, the plaintiffs had a public duty to perform; but as this sort of testing, exclusive of Sundays, had gone on for 34 years, there was no reason why it should not go on in the same way until the appeal was heard.

Mr. HUGHES said, that being his Lordship's view, he would not further press the matter.

Lord Justice ROMER: I do not think we ought to be bothered with this motion. The thing has gone on for 34 years, surely it may go on for a few weeks longer.

Mr. HUGHES said the testing would not involve Sunday labour for the Company's people if a key were given to the examiners.

Lord Justice ROMER said it was clearly of no use to go on with the application.

Mr. HUGHES said his clients were only anxious to carry out their duty. They felt that, having a declaration of the Court, they were bound to act upon it.

Lord Justice ROMER: That is quite right; but the injunction will be suspended until the appeal is disposed of.

Mr. HUGHES said he would not press the case further; but if there was a risk of it going over the Long Vacation, perhaps a fresh application might be made.

Lord Justice VAUGHAN WILLIAMS said if the Council thought it worth while to make such an application, they could do so; but it ought not to be made unless there was serious ground for supposing that in the months of August and September something detrimental to the community at large would happen if Sunday testings of gas did not take place.

Mr. HUGHES said his clients considered that the matter was one of importance.

Their LORDSHIPS directed that the costs of the present application should be costs in the appeal.

SEQUEL TO A GAS EXPLOSION AT WREXHAM.

The Steam-Roller Again.

At the Wrexham County Court, a few weeks ago, a case was tried by Sir Horatio Lloyd, in which the Wrexham Public Hall Company sought to recover from the Wrexham Gas Company the sum of £2 4s. 6d. for damages caused by an explosion of gas which occurred in the hall on the 5th of December last.

Mr. S. D. Edisbury, who appeared for the plaintiffs, said that though the amount claimed was small, the principle involved was an important one. The property of the Public Hall Company consisted of shops and a hall in Henblas Street; above the shops being a number of offices, one of which was occupied by the Supervisor of the Inland Revenue. On the above-named day, the caretaker heard some peculiar noises upstairs, and on entering the Supervisor's office found that explosions were taking place at the side of the fireplace, and that the woodwork around was on fire. The caretaker telephoned to the gas-works, and a man was sent up to examine the place. Mr. Norman Bury, the Assistant-Manager, also visited the hall to ascertain the cause of the explosions. On examination, it was found that the main running along Henblas Street, about 5 feet distant from the front door of the hall, was fractured, and the gas escaping. Mr. Bury and one of the employees admitted that when the main was fractured the gas always followed the line of the service-pipes; and so in this case the gas must have found its way along the pipes into the office. In answer to the claim, Mr. W. Heyward, the Secretary of the Gas Company, wrote to Mr. Bevan, the Secretary of the Public Hall Company, to the effect that the Directors had thoroughly considered the claim, with the result that it was quite clear that it should have been made against the Company with whom the building was insured. After further correspondence, when it was found that the Gas Company still disputed liability, the sum of £2 4s. 6d. was paid by the plaintiff Company, and they were reimbursed by the Yorkshire Insurance Company.

The learned Counsel was about to call witnesses, when Mr. Moss, who appeared for the Gas Company, said they did not dispute the facts, and there was no allegation of negligence on their part. The injury to the main was really caused by the Corporation steam-roller going over the ground after it had been opened for the purpose of laying electric cables. The Corporation had since defrayed the cost of putting the main right. There was a frost at the time; and the gas, instead of escaping through the ground, as it would have done under ordinary circumstances, followed the service-pipes into the hall. All the Company did was to discharge their statutory duty; and as the accident which had happened was quite beyond their control—having been caused by a third party—he contended that they were not liable, and that proof of negligence on their part was necessary from the

plaintiffs. After some argument, his Honour upheld Mr. Moss's contention.

Evidence was then called for the plaintiffs. Mr. R. E. Evans, the caretaker at the hall, spoke to discovering the explosions; and, referring to the laying of the electric cables, he expressed the opinion that there was no proper supervision of the work by the Gas Company. The Assistant-Secretary to the plaintiff Company (Mr. J. G. Bevan) said it was a well-known fact that the cables had been taken up more than once. Mr. Moss said it had not been shown that the gas-pipes were improperly laid. He called William Parry, a main-layer in the service of the Gas Company, who attributed the fracture of the main to something heavy passing over it. It was sound in every way, and was properly laid at a depth of 18 inches below the surface of the road. In answer to Mr. Edisbury, witness stated that the usual depth for laying mains in streets with as much traffic as Henblas Street was now 24 inches. His Honour remarked that on the previous day, at Denbigh, he had a good deal of expert evidence before him on this question, and the minimum depth for laying pipes there was given as 36 inches. Mr. Bury was then called, and he corroborated the evidence given by Parry.

Mr. Edisbury contended that there had been negligence on the part of the Gas Company in not laying their main at a greater depth than 18 inches from the surface of a busy street like the one in question. Mr. Moss, on the other hand, submitted that no negligence had been proved, and without such proof the plaintiffs could not recover.

His Honour reserved judgment, which he delivered last Wednesday in favour of the defendants.

Sale of Infringing Mantles.

In the Chancery Division of the High Court of Justice last Saturday, before Mr. Justice Swinfen Eady, the case of the *Pilot Gas-Mantle Company v. Haigh and Co.*, of Sheffield, came on for hearing. Mr. Cunliffe said this was a motion for judgment, in default of defence, in an action brought by plaintiff Company, whose headquarters were at Bolton, to restrain the defendants from selling and passing off infringing mantles. His Lordship said he remembered the circumstances. Plaintiffs were entitled to judgment in accordance with their claim. Mr. Cunliffe said when the matter was before the Court on the claim for an interim injunction, his Lordship thought the plaintiffs ought to ascertain whether the defendants were the real perpetrators of the infringement. Inquiries had been made, and they all tended to show that this was the case. Judgment for plaintiffs accordingly.

A Dublin Gas Explosion.

In Nisi Prius Court No. 1, Dublin, last Thursday week, before Lord O'Brien, Chief Justice, and a Special Jury, an action came on for hearing in which Mrs. Elizabeth Campbell claimed damages from the Alliance and Dublin Consumers' Gas Company for negligence, whereby her house, furniture, and stock-in-trade as a draper (which she valued at £697) were burnt. The defendants denied the allegations in the statement of claim, and pleaded contributory negligence. Plaintiff's evidence was to the effect that she was a customer of the defendants; and an escape of gas having occurred in the house, she communicated with the Company, who sent a man to make the necessary repairs. He took a lighted candle to the gas-meter, with the result that a flame was produced by which the house was set on fire and burnt. She had received £450 from an Insurance Company. After the case had proceeded further, a settlement was effected under which the defendants agreed to refund the money paid by the Insurance Company, and to pay the plaintiff £175 and costs.

Severe Censure of an Electric Lighting Company.

The South London Electric Supply Corporation, Limited, sued, at the Lambeth County Court on Thursday, Captain J. Linett, of 151, Loughborough Road, S.W., to recover 6s. Notwithstanding the smallness of the sum in dispute, counsel and solicitors were engaged on both sides; and the case occupied two hours. The plaintiffs alleged that the rent for the meter was 3s. a quarter. Defendant claimed that, according to agreement, the amount should be 2s. The difference for six quarters was sued for. Defendant stated that, although he had a three years' agreement with the Company, and everything claimed, except the 6s., was paid on the 19th ult., the light was then cut off, notice being given only a few hours before. He had lived in the house a quarter-of-a-century, and no person had ever occasion to call twice with an account. Judge Emden said no gas company would act in so arbitrary a manner. Instead of taking this *bonâ fide* dispute into Court, the plaintiffs inflicted upon this gentleman the disgrace of cutting off his light, for the purpose of getting their own way. He had no hesitation in saying that a company which acted in such a manner was unfit to possess public powers. Judgment was given for the defendant, with costs on the higher scale.

Rochdale Water Supply.—In their annual report, which has just been issued, the Rochdale Water Committee state that during the past year there has been an increase of 327 in the number of tenants, the total now being 29,666. Water-rentals for domestic supplies amounted to £29,414, or an advance of £732; while meter supplies produced £9128, or a reduction of £486. The sum received for water supplied by meter for trade purposes was £436, or a decrease of £319. The increase of rentals for domestic supplies continues satisfactory. The decrease of rentals for trade purposes was due to the receipts for the preceding year being unusually high, owing to the dryness of the summer of 1901. The new main to connect the Ramsden Wood reservoir with the other works is so far completed that it can be brought into use at any time. During the year the mains were extended by 1347 yards.

MISCELLANEOUS NEWS.

GAS v. ELECTRICITY IN PADDINGTON.

Decisive Victory for Gas.

Some three or four years ago, the Paddington Vestry, now the Borough Council, decided to light Westbourne Terrace by electricity as an experiment. No one can allege that the trial was not thorough and exhaustive, for it was only a few months since that, owing to the enormous expense as compared with gas, and for other reasons, notice was given to the Electric Light Company to terminate the contract. A Joint Committee, consisting of the Works and Lighting Committees, was then appointed to go into the whole question of gas *versus* electricity as an illuminant for the borough, and draw up a comprehensive scheme. At the last meeting of the Council, the Committee presented their report. They recommended that gas be used, and that the lamps on the omnibus routes and other main streets be placed not more than 20 yards apart, and in the narrow and less important side streets not more than 40 yards apart—all streets to be lighted by Kern incandescent burners. The adoption of the scheme would involve a capital expenditure of £7200 for lamps, and an annual maintenance charge of £12,100, compared with the present cost of between £8500 and £9000 After a discussion in which electric lighting was generally condemned, the Committee's recommendation was adopted.

THE WELSBACH MANTLE ACTIONS GUARANTEE FUND.

In the leader paragraphs in this issue will be found some reference to the report and financial statement which Sir George Livesey has issued to the guarantors of the Welsbach Actions Fund which was raised in the early part of last year for a purpose with which readers are well acquainted, and the result of which the gas industry is now enjoying. The total sum guaranteed was £6849; and the actual amount expended was £2649.

The gas undertakings who gave their support, the sums guaranteed; and the amounts to be paid (put in parentheses) are as follows: Aldershot, £25 (£10); Birkenhead, £150 (£57); Bolton, £200 (£76); Bromley, £50 (£19); Cambridge, £50 (£19); Cardiff, £200 (£76); Chester, £25 (£10); Commercial, £500 (£190); Coventry, £150 (£57). Crays, £20 (£9); Crystal Palace District, £300 (£114); Dover, £10 10s; (£4); Dublin, £250 (£95); Dudley, £10 (£4); Dunfermline, £10 (£6); Durham, £25 (£10); Enfield, £10 (£4); Faversham, £15 6s. 8d. (£7); Gloucester, £50 (£19); Grantham, £25 (£10); Halifax, £25 (£9); Hartlepool, £50 (£19); Hastings and St. Leonards, £50 (£19); Hereford, £12 12s. (£6); Huddersfield, £150 (£57); Maidstone, £26 (£10); Malton, £10 (£6); Newcastle, £500 (£190); Plymouth, £100 (£38); Portsea, £10 (£4); Ramsgate, £50 (£19); Richmond, £70 (£29), Rugby, £10 (£4); Ryde, £20 (£9); St. Helen's, £25 (£9); Salford, £144 (£54); Scarborough, £25 (£10); Sheffield, £500 (£190); Shrewsbury, £40 (£19); Southampton, £100 (£38); South Metropolitan, £2000 (£760); Southport, £50 (£19); Sutton, £35 (£19); Taunton, £20 (£9); Tynemouth, £34 (£13); Wakefield, £50 (£19); Walker and Wallsend, £50 (£19); Wandsworth and Putney, £150 (£57); Warwick, £15 (£6); Wellingborough, £13 (£5); West Ham, £300 (£114); Weston super-Mare, £30 (£19); Wrexham, £10 (£4); York, £75 (£29); Amounts under £10, £24 8s. (£22 5s.).

The total expenditure was £2649. Without going into particulars, this was divided as follows: Counsel, £280 14s.; to witnesses for the preparation of evidence and investigations, £1109 3s. 3d.; solicitors' charges (three firms), £1198 4s. 5d.; and translations, printing, and sundries, £60 18s. 4d. Under the head of witnesses, the largest item is "Messrs. Stanger and Blount, £687 14s. 9d." In his report, Sir George Livesey states that the delay in issuing the complete accounts is due to a dispute with Messrs. Stanger and Blount, Analytical Chemists, as to the amount of their charges. His reference to the matter proceeds: "When retained to make experiments, with a view to giving evidence, they estimated the cost at about £150, or a little more. Later, they said the investigations and experiments were more extensive than they originally contemplated, and that consequently the expense would be considerably increased. I discussed the question with Mr. Cave, the defendants' Solicitor, and remarked that 'considerably' probably meant double, and gave my consent. I certainly never imagined that it would be fourfold, or I should not have consented; and, when the bill came in, I saw Mr. Blount on the subject, and afterwards, in consultation with Mr. Cave, made what we considered the liberal offer of 500 guineas. This was not accepted; and the matter was referred. They produced scientific witnesses, who said they would have charged more, while our witnesses said the contrary; and the Referee gave the claimants the benefit of the doubt." The further paragraphs in the report are alluded to on p. 741.

BELFAST GAS SUPPLY.

In last week's "JOURNAL" (p. 680) we gave some particulars relating to the working of the Belfast Gas Department for the year ending March 31; and we are able now to supplement these by further figures from the report of Mr. James Stelfox, the Gas Engineer. The make of gas was 1,735,497,000 cubic feet, as against 1,683,983,000 feet in the previous year, or an increase of a trifle over 3 per cent. The proportions of coal gas and carburetted water gas were as follows: 1902-3, coal gas 982,688,000 cubic feet, and carburetted water gas 752,809,000 feet. 1901-2, coal gas 958,275,000 cubic feet, and carburetted water

gas 725,708,000 feet. The proportion of carburetted water gas in the two years was thus 43·37 per cent. and 43·09 per cent. respectively. The average illuminating power during the year was 16·50 candles, the make per ton of coal 10,102 cubic feet, and the oil used 2·8 gallons per 1000 cubic feet of carburetted water gas. The average price paid for coal was 16s. 2½d. per ton, which included the cost of discharging into the works and stores, and delivering into the retort-houses as required; the cost in the previous year having been 18s. 4½d. per ton. The average cost of oil delivered into the storage tanks was 2·355d. per gallon, as compared with 2·979d. At the close of the year, the consumers numbered 43,886, being an increase of 1699, or 4 per cent. The cost of coal gas into the holders was 15·678d. per 1000 cubic feet (as against 15·145d.), and of carburetted water gas 12·613d. (as against 14·669d.). The cost of the water gas would have been somewhat less but for the balance of outlay on the renewal of an oil-main, which was an exceptional item charged to revenue account. The total cost of the mixed gas, including distribution, annuities, interest and dividends on stock, and sinking fund, was 19·088d. per 1000 cubic feet, as compared with 20·824d. in 1901-2. The total outlay on new mains and services during the year amounted to £10,840; and some 279 lamps were erected, making a total of 9792, of which about 1800 have been fitted with incandescent burners.

REDUCTION IN PRICE AT SALFORD.

In accordance with the resolution of the Salford Gas Committee, the Chairman (Alderman Phillips), at last Wednesday's meeting of the Council, moved that after the 30th inst. the price of gas should be reduced by 2d. per 1000 cubic feet to all ordinary consumers, subject to the existing discounts if the bills were paid within a given time. He said that in 1901 coal went up in price by 50 per cent., with the result that the cost of the gas was considerably increased. Owing to the fall in the price of coal and the increase in the number of consumers from 47,000 to 56,078, they were able to reduce the price. They had no fewer than 16,890 consumers who used penny-in-the-slot meters. This suggestion having been agreed to, a resolution was moved by Alderman Phillips that a reduction of 1d. per 1000 feet should be made to consumers of 250,000 cubic feet and upwards per quarter. Alderman Jenkins said it was useless to reduce the price of gas if they had to advance the general rates in consequence. Alderman Phillips, in reply, said that was not his policy. The cheaper they could sell their gas the more they would sell. He could inform the Council that the trend of parliamentary opinion was opposed to gas and similar departments, which had a monopoly, paying too much in relief of rates. Alderman Snape opposed the proposal as one that was making a present of £1875 a year to wealthy manufacturers. Other members thought that something should be done first to reduce the price to penny-in-the-slot consumers. They paid 1s. per 1000 cubic feet extra. Alderman Worsley said he was going to vote for the resolution; but this did not mean that he did not see the need to help the poorer consumers. The gas-works were, after all, a commercial undertaking; but he believed there was a Sub-Committee at work trying to evolve a plan whereby they could give the prepayment consumers 30 cubic feet for 1d., instead of 25 as at present. The proposal of the Committee was carried by 30 votes to 9. Gas will accordingly be sold at an all-round reduction at the end of this month.

BATLEY CORPORATION GAS SUPPLY.

A Successful Year.

The accounts of the Gas Department of the Batley Corporation for the year ending the 31st of March have been issued; and they reveal the fact that the past twelve months were a period of very successful working, the credit for which must in a large measure be given to the management of Mr. J. F. Bromley. The net income from the sale of gas was £18,622, against £18,215 in the preceding twelve months; residuals produced £6684, compared with £6440; and the total receipts were £26,324, against £25,637. The manufacturing charges were £12,291, whereas before they were £13,345 (coal dropping from £10,129 to £9308); the expenses of management were £757, against £835; and the total expenditure was £15,427, compared with £16,536. The profit for the past year was £10,897; while in 1901-2 it was £9101. After paying the interest on the loan and meeting the instalment of the sinking fund, the balance is £4161, against £2450 before. Adding this to the accumulated profit of £6735, there is produced a total of £10,896, of which £2000 is transferred to the borough fund in aid of the rates and £2161 to the contingency fund. Last year the latter fund was increased by only £450. The amount carried to the balance-sheet is £6734—the same as before. The total quantity of gas consumed was 165,918,700 cubic feet, of which 150,319,900 cubic feet was consumed within, and 15,598,800 cubic feet beyond the borough. In the year 1901-2, the figures were: Within the borough, 146,809,100 cubic feet; beyond, 15,662,000 feet—total, 162,471,100 feet.

A GOOD YEAR AT WARRINGTON.

In his annual report on the operations of the Warrington Corporation Gas-Works, Mr. W. S. Haddock remarks that his expectation of a successful year had been more than realized. There was a net profit of over £8000, which was largely due to the lower cost of coal, for which they paid more than £4000 less than in the previous year. Wages for gas making were lower by nearly £800, owing to the more extended use of machinery and better working results. Tar and sulphate of ammonia had improved in price; and the revenue had risen about £700 for these products. Coke had, however, not realized as much; the receipts being about £300 less than in the previous year. It was now rising in price; and they hoped to have a better return for this product next year. The increased sales of gas brought in about £1700 more. At present, except on the recent dark days, the output of gas was falling, and in the past half year the sales were under half-a-million cubic feet more than in the same period of the previous year, as compared with an increase of 12 million cubic feet during the first half of the year. A lower price for gas, says Mr. Haddock, invariably led to a higher consumption; and it would therefore be advisable to reduce the price to ordinary and slot consumers. A reduction of 3d. on ordinary meters and an increase of 5 cubic feet per penny on the coin-meters would reduce their income about £5000. It would, he thinks, be advisable to give an extra discount of 3d. on gas-engines working four to five hours daily, as the consumption by engines is regular and requires less idle plant. As so many complaints are made regarding the delay in lighting the street-lamps, Mr. Haddock recommends that the Committee should extend the hours of lighting and increase the gas consumption without making any extra charge for the lamps. It is understood that the Gas Committee will carry out Mr. Haddock's suggestions, and will, in addition, increase the contribution to the relief of the rates from £2000 to £4500.

WORKINGTON CORPORATION GAS SUPPLY.

The Past Year's Working.

The Gas Manager of the Workington Corporation (Mr. George Keyte) has presented to the Gas Committee his report on the working of the undertaking in the year ending the 31st of March. The result was a gross profit of £4298, of which £2215 was required for interest, sinking fund, &c.; leaving a net profit of £2083. The whole of this has been absorbed in meeting expenditure on new consumers, providing additional mains, services, and meters, and writing off portions of the suspense account and a debit balance of £1124. The gross profit represents 17·53 per cent. on the capital outstanding on March 31, or about 9·44 per cent. on the total capital expended up to date. The quantity of gas made was 91,797,000 cubic feet, compared with 89,133,000 cubic feet in the preceding twelve months; being an increase of nearly 2¾ millions, or about 3 per cent. Of the total outsend, 32,018,000 cubic feet was "day" gas, compared with 29,057,000 cubic feet in 1901-2, or an advance of 10·1 per cent. The "night" gas was only 0·4 per cent. more than before. Of the consumers by ordinary meter, 486, or 23⅓ per cent., used less than 8000 cubic feet each during the year; their average being 5313 cubic feet. Mr. Keyte points out that as the net profit averaged 6d. per 1000 cubic feet on the total quantity of gas sold, these 486 consumers used, on an average, rather less gas than was sufficient for the profit on their consumption to cover the cost of meter hire, which is not charged. This is equivalent to a saving to users of small meters of 3½d. per 1000 cubic feet on their average consumption during the past year. A considerable proportion of the slot meter consumers did not reach the minimum necessary to make them profitable customers. These consumers are charged 2s. 11d. per 1000 cubic feet (no fittings or cooker being supplied); while the ordinary consumers pay 2s. 8d., less discounts of 2½, 5, 7½, or 10 per cent. to those who take large quantities. Mr. Keyte works with Cumberland coal, costing 12s. a ton; but it is poor stuff—the screened coal containing 100 per cent. more ash than unscreened Durham. He nevertheless produced 10,028 cubic feet of gas from a ton of it with an admixture of cannel, and also 8·43 cwt. of coke and 10·6 gallons of tar. Mr. Keyte concludes his report by giving the employees and staff of the department credit for the willing manner in which they all worked to ensure a successful year.

ELECTRIC LIGHTING NOTES.

Electric Lighting at Southport.

While gratifying in some respects, there is disappointment that the profits on the past year's working of the electricity supply undertaking of the Southport Corporation are not larger. Owing to the great increase in the interest and sinking fund charges (upwards of £1555), the financial results do not come up to expectations. The gross profit on the year's working was £12,363, equal to 7·40 per cent. on the average capital outlay, against a percentage of 7·24 last year. Interest and sinking fund absorbed £10,577; leaving a net profit of £1786. The average price obtained has dropped from 2·98d. to 2·96d. per unit sold. There has been a reduction in the total working costs of 11·8 per cent., and the percentage of total costs to revenue last year was only 39·28, which compares favourably with any undertaking in the country. The works costs now amount to only 0·85d. per Board of Trade unit generated.

Doubts and Difficulties at Penzance.

The Penzance Corporation have an Electric Lighting Order, but they do not seem to know what to do with it. At a meeting held on Friday last, the Electric Lighting Committee recommended that the Council should not accept any of the offers received, but should carry out the work themselves. Mr. W. Bazeley, in moving the adoption of the report, said that the Council had no power to sell or transfer the Order in any way that would benefit them by making any profit on the transaction, nor could they transfer their responsibility, because, in the event of a company failing to carry out the work, any loss would fall on the ratepayers. The Committee had full confidence in the future of the undertaking, and thought that, as a watering-place, Penzance was bound to have the electric light. Mr. E. A. Head expressed his astonishment at the recommendation, and said the Committee knew that the Council intended to abandon the scheme. They had no authority from the ratepayers to pledge the credit of the rates to an expenditure of £20,000 or £30,000, and had no right to make such an outlay, considering the present state of the trade in the town. He moved, as an amendment, that the report be referred back, and that

the Committee be instructed to continue their negotiations with one or more of the companies from whom the offers had been received. Mr. Barnett, in seconding the amendment, said he thought that by adopting electric lighting they would be going back to semi-obscurity compared with the present system of incandescent gas lighting in the street, as only two or three of the principal thoroughfares could be lit by it. Mr. G. Poole contended that after spending a lot of money on the Order they ought to go on with it; and he expressed the opinion that they should either proceed with the scheme themselves or give it up. The amendment was carried by seven votes to four; so that there are to be further negotiations before a final decision is arrived at.

"Profit" Making at Plymouth.

In the course of his annual report on the Plymouth municipal electricity undertaking, Mr. E. G. Okell, the Borough Electrical Engineer, says that the demand for electricity for lighting purposes in the centre or business part of the town is good, but that as to the residential districts, although a fair number of private houses are being supplied, not more than the fringe of this class of custom has been touched. He advocates the laying of cables in readiness for demand, as otherwise the business is difficult to secure. The cost of production is being steadily reduced, and was last year 1·612d. per unit, as compared with 2·19d. in the previous year. At the meeting of the Town Council yesterday week, when this report, together with that of the Borough Treasurer, was submitted, Alderman Radford, the Chairman of the Committee, said that gratifying progress was being made; there being a net profit of £2601 on the year. It might be said, on the other side, that the undertaking was not bearing the whole of its capital charges. This was perfectly true. Last year they had to meet charges in respect of capital amounting to £4400. This year they totalled £5600; and if they had to meet the charges for the whole of the capital expended, they would have amounted to £2000 more. But it was perfectly right that in a young undertaking the whole of the charges for interest and sinking fund should not be put on the working in the first year or two, because a large amount of the capital was still unproductive. The figures of the Electrical Engineer as to the reduction in the cost of production were extremely gratifying. Mr. S. J. Page said the so-called "profit" was not profit at all. It was due, in the first place, to the excessive charge made for current for the municipal trams; and in the second to the fact that no provision was made for a sinking fund in respect of the sum of £60,000 which the Committee had spent without authority. It must be remembered, moreover, that the machinery was depreciating, and no depreciation fund had been formed. There was a serious state of things in store for the ratepayers of the future. Mr. A. R. Debnam held that the undertaking was being run upon solid business lines. If there was no sinking fund in respect to some of the capital, it must be remembered that there was considerable expenditure in excess of immediate requirements. Mr. R. R. Monk, the Chairman of the Tramways Committee, said the profit on the electricity undertaking had been created by the fact that the tramways were such a good customer. The reports were adopted.

SOUTHWARK AND VAUXHALL WATER COMPANY.

The Half-Yearly General Meeting of this Company was held at their Offices, Southwark Bridge Road, last Tuesday—Alderman Sir H. E. KNIGHT in the chair.

The SECRETARY (Mr. Montague Watts) having read the notice calling the meeting, and other formal business having been disposed of, the report and accounts for the six months ending March 31 last were presented.

The CHAIRMAN said he had had the pleasure of addressing between fifty and sixty meetings of the Company, and he felt very great regret indeed at the thought that the connection between the proprietors and the Directors, which had been so happy and had led to so much prosperity, was soon to be terminated. They must, however, bow to the decision of Parliament. Dealing with the accounts, he stated that they were signed by the Company's Auditors, but not by the Government Auditor. The Board very much regretted this, the more so because they felt that there was no legitimate reason why Mr. Stoneham's signature should have been withheld. Only one point was in dispute—viz., the question of the costs incurred by the Company in consequence of the passing of the Metropolis Water Act, 1902. He dwelt on this matter on the last occasion, when the same difficulty arose; but he would now make the proprietors more fully acquainted with the ground which the Directors had taken up. By section 23, subsection 8, of the Act, it was enacted that the Court of Arbitration "may make such allowance as they think just for covering any costs, charges, and expenses which have been incurred in consequence of the passing of this Act by any Metropolitan Water Company, and which ought, in the opinion of the Court, to be borne by the Water Board." He especially desired to call the proprietors' attention to the words "which have been incurred." "Have been" must be something which occurred before the Act received the Royal Assent; and as the expenses in dispute were incurred in consequence of the passing of the Act, the Directors contended that these ought not by right to be charged against the revenue at the present time, but that, as the Act said, it was for the Court of Arbitration to decide how far such expenses should come against the revenue or from other sources. This was the ground the Directors had taken up; and they would not submit to £1900 or £2000 being brought against revenue at the present time, when the Act stated that it was for the Arbitrators to decide whether the amount should be paid by the Company or the Board. As a commercial man, he confessed that he did not see what the matter had to do with the Auditor at all. The Directors admitted the liability, and placed it in the accounts for everyone to see it; and they were prepared to put it in suspense, which would mean that it was to be dealt with properly afterwards. Having done this, he thought the Auditor's requirements were, and ought to be, satisfied. If there was a question of the interpretation of an Act of Parliament, it was not a matter for the Auditor to settle. Mr. Stoneham might have appended

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 804.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.	GAS COMPANIES.			£ s. d.
590,000	10	April 17	10½	Alliance & Dublin 10 p.c.	19–20	..	5 5 0
120,000	10	,,	7½	Do. 7 p.c.	13–14	..	5 7 2
200,000	5	May 14	6½	Bombay, Ltd.	5⅞–6	..	5 8 4
140,000	5	,,	6½	Do. New, £4 paid	4–4½	..	5 15 7
380,000	Stk.	Feb. 26	12	Brentford Consolidated	240–245	..	4 18 0
286,700	,,	,,	9	Do. New	178–183	..	4 18 4
50,000	,,	,,	5	Do. 5 p.c. Pref.	131–136	..	3 13 6
206,250	,,	June 11	4	Do. 4 p.c. Deb.	108–111*	..	3 12 1
220,000	Stk.	Mar. 12	10⅝	Brighton & Hove Orig.	212–217	..	4 19 1
246,320	,,	,,	7⅛	Do. A. Ord. Stk.	151–156	..	4 19 4
460,000	20	Mar. 31	10	British	39½–40½	+½	4 18 9
100,000	Stk.	Mar. 12	6	Bromley, 5 p.c. "A"	118–123	..	4 17 7
165,700	,,	,,	4¼	Do. 3½ p.c. "B"	90–95	..	4 14 9
500,000	10	May 14	7	Buenos Ayres (New) Ltd.	11¼–11½	..	5 19 2
250,000	Stk.	Dec. 30	4	Do. 4 p.c. Deb.	94–96	..	4 3 4
150,000	20	Mar. 12	8½	Cagliari, Ltd.	23–25	..	6 12 0
100,000	10	June 11	10	Cape Town & Dis., Ltd.	14½–15¾*	..	6 9 0
50,000	50	May 2	6	Do. 6 p.c. 1st Mort.	52–54	..	5 11 1
1,375,000	Stk.	Feb. 26	5	Commercial 4 p.c. Stk.	103–106	..	4 14 4
503,750	,,	,,	4¾	Do. 3½ p.c. ,,	99–102	..	4 13 2
407,812	,,	June 11	3	Do. 3 p.c. Deb.,,	87–90*	..	3 6 8
800,000	Stk.	June 11	8	Continental Union, Ltd.	125–130*	+1	6 3 1
200,000	,,	,,	7	Do. 7 p.c. Pref.	137–142*	..	4 18 7
575,000	Stk.	Feb. 26	5⅛	Crystal Palace Ord. 5 p.c.	113–118	..	4 10 2
60,000	,,	,,	5	Do. 5 p.c. Pref.	120–125	..	4 0 0
106,158	,,	Jan. 15	5	Do. 5 p.c. Deb. Stk.	137–140	..	3 11 5
486,000	10	Jan. 29	10½	European, Ltd.	18–19	..	5 10 6
354,060	10	,,	10½	Do. £7 10s. paid	13–14	..	5 12 6
15,243,200	Stk.	Feb. 12	4⅛	Gaslight and Coke	4 p.c. Ord.	84–86	−1	5 2 4
2,600,000	,,	,,	3½		3½ p.c. max.	85–87	..	4 0 6
3,799,735	,,	,,	4		4 p.c. Con. Pref.	108–110	..	3 12 9
4,193,975	,,	June 11	3		3 p.c. Con. Deb.	86–88*	..	3 8 2
252,500	Stk.	Mar. 12	5	Hastings & St. L. 3½ p.c.		90–95	..	5 5 3
70,000	10	June 11	8	Hongkong & China, Ltd.		15–16*	+⅛	5 0 0
3,800,000	Stk.	May 14	10	Imperial Continental		203–208	..	4 16 1
473,600	Stk.	Feb. 12	3½	Do. 3½ p.c. Deb. Red.		100–103	..	3 8 0
165,242	Stk.	Mar. 12	6	Lea Bridge Ord. 5 p.c.		115–120	..	5 0 0
561,000	Stk.	Feb. 26	10	Liverpool United A		217–219	..	4 11 4
718,100	,,	,,	7	Do. do. B		166–168	..	4 3 4
306,083	,,	Dec. 31	4	Do. do. Deb. Stk.		112–114	..	3 10 2
75,000	5	June 11	5	Malta & Medn., Ltd.		4¼–4⅜*	..	5 5 3
560,000	100	April 1	5	Met. of	5 p.c. Deb.	103–107	..	4 13 6
250,000	100	,,	4½	Melbourne	4½ p.c. Deb.	102–104	..	4 6 7
541,920	20	June 11	3½	Monte Video, Ltd.		9⅜–10⅜*	..	6 13 4
1,515,892	Stk.	Feb 20	4½	Newc'tle & G'tesh d Con.		104–105	..	4 5 9
376,855	Stk.	Jan. 2	3½	Do. 3½ p.c. Deb.		96½–97½	..	3 11 10
300,000	Stk.	May 14	8	Oriental, Ltd.		140–145	..	5 10 4
600,000	5	Mar. 31	7	Ottoman, Ltd.		6–7	..	5 0 0
205,005	Stk.	Jan. 15	6¼	Ply'mth & St'house 5 p.c		127–132	..	4 12 9
851,070	10	April 30	7	River Plate Ord.		11¼–11⅝	..	5 19 2
300,000	Stk.	Dec. 30	4	Do. 4 p.c. Deb.		95–97	..	4 2 6
250,000	10	April 17	8	San Paulo, Ltd.		12–13	..	6 3 1
135,000	Stk.	Mar. 12	10	Sheffield A		239–241	..	4 3 0
209,984	,,	,,	10	Do. B		237–240	..	4 3 4
523,498	,,	,,	10	Do. C		237–239	..	4 3 8
103,235	Stk.	Mar. 31	5	Shrewsbury Ord, 5 p.c.		111–114	..	4 7 9
6,000,000	Stk.	Feb. 12	5⅛	South Met., 4 p.c. Ord.		119–122	..	4 7 4
1,780,000	,,	Jan. 15	3	Do. 3 p.c. Deb.		50–52	..	3 5 3
380,940	Stk.	May 14	5	Southampton Ord.		105–110	..	4 10 11
87,950	,,	Jan. 15	4	Do. 4 p.c. Deb.		103–106	..	3 15 6
120,000	Stk.	Feb. 26	6	Tottenham and Edmonton	A. 5 p.c.	117–122	..	4 19 4
300,520	,,	,,	4½		B. 3½ p.c.	56–59	..	4 10 11
182,380	10	June 11	8	Tuscan, Ltd.		8–9*	..	8 17 10
149,900	10	Jan. 2	5	Do. 5 p.c. Deb. Red.		99–101	+5	4 19 0
730,872	Stk.	Mar. 12	5	West Ham, 5 p.c. Ord.		95–100	..	5 0 0
				WATER COMPANIES.			
780,776	Stk.	Dec. 30	11½	Chelsea, Ord.		325–335	..	3 8 8
150,000	,,	,,	5	Do. 5 p.c. Pref.		148–153	..	3 5 4
160,000	,,	,,	4½	Do. 4½ p.c. Pref. '75		130–140	..	3 4 4
175,785	,,	Mar. 31	4½	Do. 4½ p.c. Deb.		137–142	..	3 3 5
1,720,560	Stk.	Mar. 31	8	East London, Ord.		246–251	+1	3 3 9
654,740	,,	June 11	4½	Do. 4½ p.c. Deb.		138–143*	−2	3 2 11
1,282,943	,,	,,	3	Do. 3 p.c. Deb.		94–96*	−½	3 2 6
700,000	50	June 11	10	Grand Junction	10 p.c. max.	140–143*	+4	3 9 11
310,000	Stk.	Mar. 31	4		4 p.c. Deb.	123–128	..	3 2 6
708,000	Stk.	Feb. 26	10½	Kent		300–310	..	3 7 9
160,000	,,	,,	7	Do. New, 7 p.c. max.		200–210	..	3 6 8
1,043,800	100	Dec. 30	11	Lambeth, 10 p.c. max.		320–330	..	3 6 8
406,200	100	,,	8½	Do. 7½ p.c. max.		225–235	..	3 12 4
350,000	Stk.	Mar. 31	4	Do. 4 p.c. Deb.		122–127	..	3 3 0
500,000	100	Feb. 12	12⅝/10	New River, New Shares		430–440	..	2 18 2
1,000,000	Stk.	Jan. 29	4	Do. 4 p.c. Deb.		123–128	..	3 2 6
902,300	Stk.	June 11	7½	South-wark and Vauxhall	Ord.	277–282*	−1½	2 13 2
126,500	100	,,	7½		7½ p.c. max.	200–220*	−½	3 8 2
489,200	Stk.	,,	5		5 p.c. Pref.	148–153*	+½	3 5 4
1,019,585	,,	Mar. 31	4		4 p.c. A Deb.	122–127	..	3 3 0
1,155,066	Stk.	June 11	10	West Middlesex		303–308*	−2½	3 4 11
200,000	,,	,,	4½	Do. 4½ p.c. Deb.		136–141*	..	3 3 10
200,000	,,	Mar. 12	5	Do. 3 p.c. Deb.		95–97	..	3 1 10

* Ex div.

his name to the accounts with any note he pleased; and the Directors would have had no objection to this, or to anything being put in the accounts that was right and clear. But they did object to having a charge put against revenue which Parliament had enacted should be decided by some other authority. The consequence was that the Directors would now pay the dividend they recommended without the Government Auditor's signature to the accounts; and as this was the second time this had occurred, it was necessary for them to request Mr. Stoneham to state his requirements forthwith. The Directors would then give him notice about going to arbitration to have the question decided. With reference to the revenue account, the maintenance charges were £65,751, or £2287 in excess of those in the corresponding period of last year. Having explained the cause of the increase, and remarked that the charges under the head of "Management" were very much the same as they were a year ago, the Chairman alluded to the item, on the other side of the account, of water-rents received; pointing out that they amounted to £156,638, against £144,552 for the corresponding period of the previous year. This was an exceedingly satisfactory increase; but in the half year under review they received from the East London Water Company, for water supplied to them, £8250 more than they received in the March half of 1902. Taking away the receipts derived from the East London Company, which were abnormal, an improvement was shown in the water-rents received of £3576 from legitimate sources—namely, increased consumption in their district. This was very satisfactory, because it represented between £7000 and £8000 for the year, or quite two-thirds of 1 per cent. He thought that a Company which was progressing so satisfactorily as this was in a position of the greatest possible prosperity. The amount transferred to the dividend and interest account was £76,587, or £7087 more than it was a year ago. But the £7087 was reduced by other items (which he specified) to £2282; and the amount applicable to dividend was £39,679, against £37,397 a year ago. The Directors proposed to pay a dividend at the rate of 7½ per cent. per annum; leaving a balance of £1103 to be carried forward. He congratulated the proprietors on the increased dividend and on the Company's prospects for next half year, which, consequent on the saving at Battersea, enabled them to look with considerable assurance to the dividend being not only maintained, but also, possibly, increased. With respect to the report, reference was therein made to the fact that the Company's claim had been sent in to the Court of Arbitration. In preparing it, the Directors not only took the greatest possible care themselves, but they also called in to their aid the assistance of eminent engineers, accountants, and surveyors, preferring that the claim put forward on behalf of the Company should be corroborated by men of the highest position. There was not an item in regard to the substantiation of which he had the slightest doubt; but, of course, he did not know what the other side might say to it. Another matter of great importance to the proprietors was referred to in the report—the intercommunication works, a very large proportion of which fell upon the Company to construct, though they had no necessity for them, as they had already provided for their future requirements. Though it involved considerable pecuniary sacrifice, the Directors had thought it to the interests of the Company to join in these works in order that the question of the water supply of the Metropolis might be placed beyond the possibility of doubt. Having given particulars in regard to the Company's share in these works, the Chairman referred with gratification to the wells, by means of which, he said, he had not the slightest doubt that the Company would be in a position to supply their district without drawing any more water from the Thames than the 24½ million gallons they were already authorized to take under their original Acts of Parliament. It was a grievous thing that their property should be bought at the present time, for if they were left alone for another four or five years, the Directors would be able to pay the proprietors the maximum dividends to which they were entitled, as well as back dividends, and they would be in the possession of works which would carry the Company on to very many years into this century. He congratulated the proprietors that the Company were in such an exceptionally favourable position, which he hoped would have its due effect in bearing on the amount to be paid for their undertaking, which was to be taken from them by compulsion and against their will. An important fight was before them; but he believed it would be conducted fairly, though, as they were all aware, every item would be disputed, and every effort made to detract from the value of their undertaking. The Directors were, however, prepared to meet the contest; and they would go into the Court of Arbitration feeling confident in the honesty and stability of the position put forward on the Company's behalf. He concluded by moving the adoption of the report and accounts.

Mr. C. M. VIALLS seconded the motion, and it was carried.

Dividends were afterwards declared at the rate of 5 per cent per annum on the preference stock, and 7½ per cent. per annum on the ordinary stock and class "D" shares.

A cordial vote of thanks was passed to the Chairman, Directors, and staff; and the proceedings terminated.

GRAND JUNCTION WATER-WORKS COMPANY.

The Ordinary Half-Yearly General Assembly of the Proprietors was held at their Office, South Molton Street, last Wednesday, under the presidency of Mr. FREDERICK TENDRON, F.G.S.

The SECRETARY (Mr. J. Goodwin) having read the notice convening the meeting,

The CHAIRMAN proposed the adoption of the report and accounts. He stated that the actual amount made during the half year was £60,072—that was the net amount available for dividend. After deducting the dividend for the "C" and "D" shares, there remained £43,797 available for the maximum 10 per cent. shares. This represented the rate of 10·36 per cent. per annum, which compared with 10·04

Taxes on Food

mpairing its Nutritious Qualities, are self-imposed by neglecting to obtain

MODERN COOKING APPLIANCES.

Cannon Gas Cookers

Are perfect Cookers and offer advantages to all.

The Popular Stove for Hiring Out.

MANUFACTURERS—

CANNON IRON FOUNDRIES, LTD.,

(GAS STOVE DEPARTMENT),

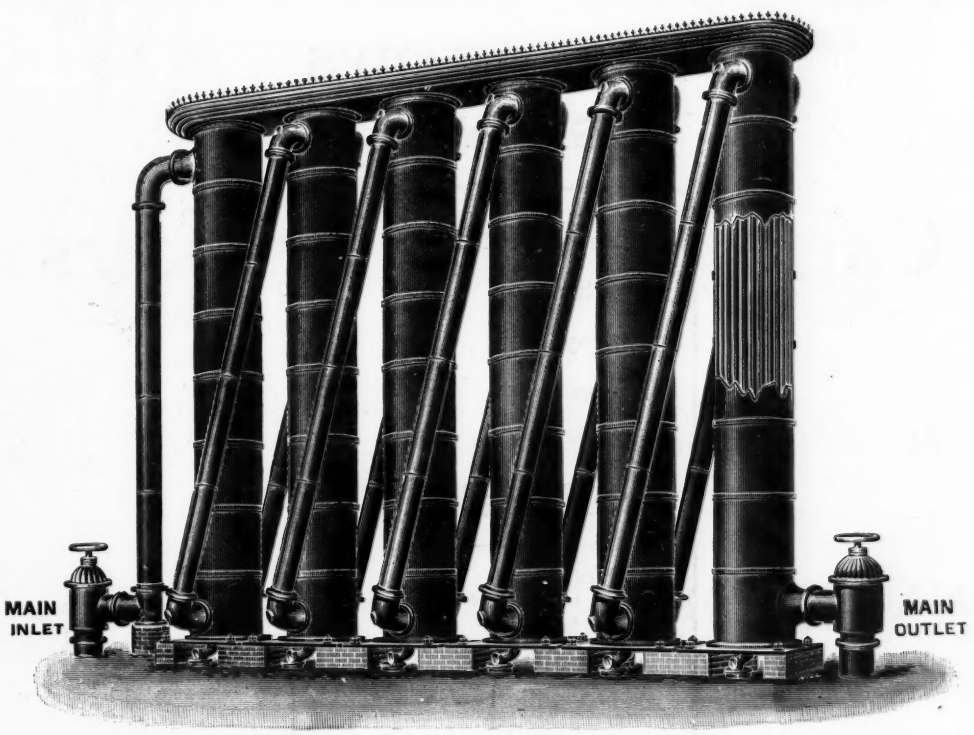
DEEPFIELDS, NEAR BILSTON, STAFFS.

AND 57-60, HOLBORN VIADUCT, LONDON, E.C.

per cent. for the year before, 9·90 per cent. for 1901, and 9·40 per cent. for 1900. The proprietors would thus see that the dividend was progressive; and he fully expected that, when the result of the half-year's working to September 30 next was added to the result of the half year under review, it would be found that the earnings for the whole year would be rather higher than the rate of 10·36 per cent. to which he had referred. If he went back farther, the same general fact of progressive net profit would be seen—a fact attributable to the large growth of the Company's district. In the course of the past half year, for instance, 1337 new supplies had been furnished by them. He wanted the proprietors clearly to grasp the point that they were not now dealing with an exceptional half year. They might feel absolutely certain that the income would be continually progressive so long as there was that increase in population to which London had been accustomed, both from the excess of births over deaths and also from the large immigration which took place from the whole of the surrounding country. Another matter which was very much in the Company's favour in the future was that their works were not only in a most efficient condition, but were also far in excess of their present requirements. For several years to come, therefore, they might look forward to being able to supply the increased demand which would be made upon them without expending any further capital excepting for mains. For the first time in the history of the Company, the accounts did not bear the signature of the Government Auditor. He was very glad to state that this was not owing to Mr. Stoneham's ill-health or death, but to his conscientious objection to passing certain items in the accounts, to which he (the Chairman) would refer. The whole of the work connected with the Staines reservoirs was to a large extent completed; but before they could be taken over by the Joint Committee, it was essential that their stability and general condition should be tested. Therefore, the Contractors, following the ordinary course in these matters, applied to the proper authority—the Thames Conservancy—for power to take water from the river for this purpose. The Conservancy entered into an agreement with the Contractors, for which the latter made a certain payment, and the reservoirs were thereupon filled, with, he believed, perfectly satisfactory results. It was essential for the works that this water should remain in the reservoirs, although he had been told that they would not materially suffer if they were kept without water for a couple of years. He, however, thought that the Joint Committee would be greatly to blame if they were to require the Contractors to return the water to the Thames—in fact, if this were done, he thought that the Water Board would have just ground for complaint. He could see no reason why the water should not remain in the reservoirs for their protection, without giving any just cause for Mr. Stoneham's contention. However, the Government Auditor, in a letter addressed to the Secretary, said: "The mere fact that the reservoirs are full of water is proof that water has been 'obtained by means of the works by that Act authorized'"—the section was 81 of the Staines Reservoirs Act—"and that the liability to make the prescribed payment to the Chamberlain of the City of London from the accruing revenues of the Company has matured." He (the Chairman) asked the proprietors to take note of those words in the Act: "Water obtained by means of the works by that Act authorized." He maintained that the common-sense interpretation of this passage was that when one of the three Companies who were to have the water from the Staines reservoirs obtained it by means of those works, that Company would come under the sinking fund clause. It could not grammatically be said that a reservoir "obtained water;" but a Company could do so. At present, however, they had not obtained any water, nor had they wanted to obtain any. Neither the West Middlesex, the New River, nor this Company required water; and as far as they themselves were concerned, he did not think that they were likely to require water for several years to come. How, then, could they be said to have "obtained water?" He desired every proprietor to form his own common-sense judgment on this point, apart from any question of law, although, he maintained, the words were so plain, even as a legal question, that he could not conceive how Mr. Stoneham should have so misapprehended them. Moreover, in view of the immense advantage which the public would get from the Staines reservoirs in the future, and the amount of public good done by the Companies who had constructed them, he thought that if there had been any doubt as to the meaning of the words, the decision should have been given by an impartial and independent man like the Government Auditor, not against the Company, but in favour of them. The second matter to which Mr. Stoneham objected was the entry which appeared on both sides of the balance-sheet of the amount of payments made by the Company for interest in connection with the reservoirs—payments the return of which the Directors would, of course, claim on behalf of the Company. Until the Purchase Bill passed, they were in this position—that they were to have the enormous benefit of the water from these reservoirs for 25 or 30 years. It was therefore a charge upon their revenue so long as in the future they got the profit and advantage; but once the Bill became law, which it did on Dec. 18 last, the Directors were bound, in the very first accounts they submitted to the proprietors, to take the changed circumstances into view, and to state the accounts in the form they should actually bear as indicating the Company's position. On June 24, 1904, the Staines reservoirs would, by the Water Bill, pass out of the hands of the Joint Committee, which would be dissolved, and the new authority would be in possession, and were bound to pay all the debts and liabilities connected with the Staines works. The Directors would then say that the time had come for the Company to be repaid what they had practically advanced on account of these reservoirs. Up to the present time, the amount thus advanced was £45,281, which appeared in the balance-sheet as having been taken from profits and as being due to profits. It was not entered in the profit and loss account, nor was it used for back dividends; it was shown as in suspense, *sub judice*, until the rightful authorities, the Arbitrators, decided the question. This point, again, seemed to be so clear to him that he was surprised that Mr. Stoneham did not sign the accounts, putting in a note stating that the £45,000 was open to decision, and could not be

CONDENSERS.

WATER COOLING.



ATMOSPHERIC.

C. & W. WALKER, LTD., Midland Iron Works: DONNINGTON, SALOP. London Office: 110, CANNON STREET, E.C.

treated as an absolute asset or divided among the proprietors. The Directors did not claim to do this, but put the amount in the balance-sheet in the position they professed to hold before the Arbitrators. The point had been submitted to Mr. Balfour Browne and other eminent Counsel who agreed that the Board had taken up the proper attitude in connection with it. Of course, the proprietors were all interested in the rise which had taken place in the market value of the London water stocks. He thought that this advance was mainly attributable to the fact that the clever men on the Stock Exchange, as well as among the public, had seen that, by the acquisition of the undertakings, the future profits of the latter must come under consideration, and be paid for at once—that was to say, 12 or 18 months hence, or whatever it might be. But instead of waiting for all the prospective profits to which he had referred, they would receive payment at once. The Stock Exchange appreciated an undertaking by the return it paid far more than by what its future earnings might be. The knowledge that years afterwards a company would be earning more would not affect the stock so much as the fact that at a fixed time the proprietors would get their prospective profits under discount. The purchaser, however, did not suffer by the immediate payment being made if he treated the payment in full as capital, and the discount as the return on the prepayment. Again, the purchaser, or the Water Board—the citizens of London—would have all the future profits of supplying water to this vast Metropolis when once the shareholders were given the return which Parliament had fixed for them. It mattered but little, therefore, if London suffered for a short time, and if, as had been said, there should be an excess of expenditure of £250,000. What was this amount, considering what the lifetime of London would be? To quote the figures of their colleague, Mr. Walter Hunter, there would be a profit on the Staines works alone, after those who had constructed them had received all they were entitled to, of over £1,000,000. Yet they were bound, by the clause in question, not to ask for compensation for transferring these reservoirs; and they had a Government Auditor who would actually like to make them pay the sinking fund! Another advantage which London would enjoy was that they would not have an outrageous sinking fund. The word "outrageous," according to the Century Dictionary, meant "immoderate—excessive;" and he did not think anyone would deny that the fund at the present time was either immoderate or excessive. The sinking fund for the Water Board was fixed for 100 years, and no payment would have to be made for the first 20 years to the sinking fund. This was an immense advantage; and at the end of 100 years London would be in this splendid position—that its water supply would stand as a free gift to their descendants. The first Company to come before the Arbitrators would be the East London; then the New River Company. The Grand Junction Company's claim would afterwards be dealt with. The Directors had taken measures by which the Company's interests would be presented in the most effective way possible; and he desired to state that they were immensely indebted to their excellent Solicitor, Mr. Bonnor-Maurice.

The Right Hon. Viscount KNUTSFORD, in seconding the motion, observed that the proprietors might feel assured that everything that could be done had been done with the view of protecting their interests. They might rely upon it that, as Mr. Tendron had said, their case would be presented to the Arbitrators in the best possible shape.

The resolution was carried unanimously.

On the motion of the CHAIRMAN, seconded by Mr. HENRY MOTT, a resolution was then passed declaring a dividend for the last financial half year at the rate of 10 per cent. per annum on the £50 "A" and the £25 "B" shares, 7½ per cent. per annum on the £25 "C" shares, and 7 per cent. per annum on the £50 "D" shares.

The CHAIRMAN afterwards proposed the re-election of the retiring Directors—Viscount Knutsford, the Hon. Sydney Holland, and Sir John C. R. Colomb, M.P.

Mr. FRANCIS TAGART seconded the motion, which was carried.

Mr. C. P. CROOKENDEN was afterwards re-elected an Auditor of the Company's accounts.

On the motion of Mr. W. H. BAKER, seconded by Mr. DANIEL STOCK, a cordial vote of thanks was then passed to the Chairman, the Directors, and the staff, in recognition of the way in which the Company's property had been conserved during the trying crisis which had been experienced for so many years.

The CHAIRMAN acknowledged the vote, and the proceedings then terminated.

SHEFFIELD CORPORATION WATER SUPPLY.

General Manager's Annual Report.

The accounts of the Water Department of the Sheffield Corporation for the year ending the 25th of March, with the report of the General Manager (Mr. William Terrey), have lately been issued. The total capital expenditure in connection with the existing works up to March 25, 1902, was £2,355,208; and in the past twelve months there was an addition of £18,856—making a total of £2,374,064. On the works in the Little Don Valley, a sum of £125,291 was spent—bringing up the total outlay to £643,096; and on the Rivelin tunnel, under the Derwent Valley Water Act, £1832. The total capital expenditure up to the date of the report was therefore £3,018,992. The income derived from water-rents for domestic and trade purposes amounted to £133,433, against £136,180 in the previous year; showing an increase of £451 from water supplied for domestic purposes, and a decrease of £3198 from that used for trade purposes by meter—a net decrease of £2747 (*i.e.*, after further reduction of water-rents from Sept. 29, 1901). The receipts from meter-rents, house, land, and mill-rents, and plumbing work, &c., came to £6785; making the total income from all sources £140,218—a decrease of £2420 compared with the previous year. The expenses of maintenance and management (less *per contra* items) amounted to £30,160; showing an increase of £543 compared with the

HOUSEMAID'S GLOVES

Are needless where they use the

"Eureka."

No Coal to handle

No soiled fingers.

year 1901-2. The net revenue was £110,058, on which are the following charges: Annuities, £60,844; interest on Corporation stock and mortgages, £22,908; and Langsett Works (interest on costs of Act of 1896), £285—making together £84,037, being an increased charge of £1724 over the previous year. This left a net profit on the year's working of £26,020, against £30,708 for the year 1901-2. The annual instalment set aside out of revenue for the redemption of annuities and the extinction of the loan indebtedness amounted to £10,218; leaving a surplus for the year of £15,802, or a decrease of £7352. The satisfactory progress that has taken place in the finances of the water undertaking since its acquisition by the Corporation on Jan. 1, 1888, is shown by the following figures: Surplus on March 25, 1902, £86,116; surplus for year to March 25, 1903, £15,802—making together £101,918, after discharging all liabilities, including the sinking fund. The additional number of houses supplied during the year was 2125, giving a total of 94,766. The additional number of baths supplied was 955; making a total of 8983. There are 3615 water-meters now in use, against 3580 last year. The total domestic and trade supplies on the 25th of March last was 149,065; being an increase of 7736 "new supplies" during the year. Mr. Terrey closes his report with some particulars as to the progress of the works in the Little Don Valley.

The report above referred to came before the City Council, at their meeting on Wednesday, in the minutes presented by the Water Committee. The Chairman of the Committee (Alderman Gainsford), referring to the accounts, said the falling off in the available surplus by £7352 seemed to be not altogether understood. He wished to make it clear that it was not on account of diminution of revenue earned on an equal footing. The Committee had been greatly reducing the rates for water during the last five or six years, until they had wiped off the whole of the 25 per cent. extra charges. Therefore, if the Council wished to compare the earning power of the Water Department in different years, they must in the first place compare the revenue as it now was with what it would have been had the old rates been maintained. If this were done, a rather remarkable and interesting result was obtained. From the time the Corporation took over the water-works until the end of 1897, the rates for water were unaltered, and the comparison, therefore, was true. If they continued the comparison on the same basis forward, the figures of gross revenue went on increasing without any intermission—every year advancing on the previous year, until 1903, when the gross revenue on the old basis would have given a total of £165,937. What he wished to point out was that, for purposes of comparison in the past as compared with the previous year, there was an actual increase of revenue of £4184. There had to be set against this an increase in the working expenses of £544, in the interest on capital of £1724, and in the sinking fund payments of £2664; making a total of £4932. Hence, though the payments for the sinking fund—*i.e.*, for the buying out of the freehold of the concern—had increased by £2664, yet, paying all this and the increased charges for management and interest, they had an adverse balance of only £758 compared with the previous year. To be added to this was the sum of £6604, which they had been able to remit by taking off the balance of 25 per cent. extra charges. These two items—making £7362 together—represented the sole diminution in the net balance on an equal basis as compared with the year 1901-2. This showed an amount of elasticity and recuperative power in the Water Department of Sheffield which was very interesting, and which in future years would be very valuable to the community. Mr. Senior asked where any item for depreciation was shown in the accounts. Alderman Gainsford replied that when a concern had arrived at maturity, like the water undertaking, there would require to be no depreciation fund at all; the maintenance fund would do everything. The water-works had been going for a couple of generations or more, and it was perfectly well known what was required for their maintenance, to secure that at the end of the year they were worth absolutely as much as at the beginning. This amount had been spent out of revenue, and therefore nothing more was to be said on the subject. The minutes were passed.

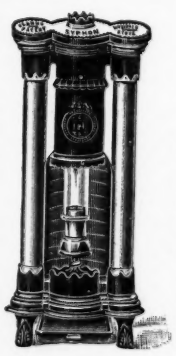
Before dealing with the accounts of the Water Department, Alderman Gainsford referred to the position of Mr. Terrey, the General Manager, and said he wished to express what he felt sure everyone in the Council would concur in—viz., that the end of the business in connection with his appointment as Clerk to the Metropolitan Water Board left them with their Manager still in their service. He (Alderman Gainsford) had experienced rather mixed feelings in this matter, regarding it, from the point of view of Mr. Terrey, as a matter of grievous disappointment that a position such as that to which he secured election, and which was the very highest his profession had to offer, had to be declined because of certain conditions attached to it; while, on the other hand, he could not but rejoice at the prospect that Mr. Terrey's services would still be retained to Sheffield. He must confess he did not think the Metropolitan Water Board had behaved in all respects quite fairly to Mr. Terrey and the other candidates, in not letting it be known beforehand what the conditions of the appointment were to be, and in actually forbidding the applicants, in the terms of their advertisement, to make such personal inquiries as would have enabled them to know what those conditions were. These remarks gave rise to a rather warm discussion, in the course of which Alderman Gainsford's conduct in connection with Mr. Terrey's application for the appointment was criticised. But he was able to satisfactorily answer the various speakers.

The taxed costs which the Marylebone Borough Council are required to pay the Metropolitan Electric Supply Company in respect of the arbitration by which the former sought to become possessed of the latter's Marylebone undertaking, amount to £10,698. The Umpire's award against the Council, as is already known, was for £1,212,000 as the purchase price of the property up to Dec. 31, 1901.

Economy Pays.

SUPPLY YOUR CONSUMERS WITH AN ECONOMICAL GAS HEATING STOVE AND THE COAL FIRE WILL BE OF THE PAST.

CLARK'S PATENT "SYPHON" STOVES.



EMIT NO SMOKE. GIVE NO SMELL.
NO DIRT OR TROUBLE. NO DANGER.

The "Syphon" is the simplest and most economical apparatus for producing heat.
It gives invariable satisfaction to consumers, both from efficiency and economy in use.

CONSUMERS APPRECIATE AN . . .
. . . ECONOMICAL HEATING STOVE.

Sold and let out on Hire by all leading Gas Companies.

CATALOGUES AND FULL PARTICULARS ON APPLICATION TO:

S. CLARK & CO., Patentees and Makers, Compton Works, Canonbury Road, HIGHBURY; & "Syphon" Works, Islington, LONDON, N.
Show-Rooms: Bath House, 58, Holborn Viaduct, E.C.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

At the meeting of the Edinburgh and Leith Gas Commissioners on Monday, the Treasurer (Mr. John S. Gibb) directed attention to the great increase in the Commissioners' business during the five years. The cash account in the general ledger showed that for the five years ending May 15, 1896, the total cash transactions amounted to £4,107,164, which was equal to an annual average of £821,433; and for the five years to May 15, 1901, the total was £6,581,537, or an annual average of £1,316,307. The increase in five years was thus £2,474,373; and the increase on the average annual amount was £494,874—or at the rate of over 60 per cent. per annum. The revenue for the five years to May 15, 1896, was £255,908, and for the next five years it was £275,551—an average annual increase of £19,643, equal to about 8 per cent. In the collector's department, the number of payments rose from 1,078,409 (equal to an annual average of 215,682) to 1,284,542, which is equal to an annual average of 256,908. The annual increase was thus 41,226 payments, which was equal to 19 per cent. At May 15, 1891, the loan capital account amounted to £104,698; at May 15, 1896, it amounted to £134,698—an increase in five years of only £30,000; but at May 15, 1901, it amounted to £638,022—an increase during the later five years of £503,324. The Treasurer made recommendations as to increases in the various departments, which will involve an annual charge of £180. The Commissioners unanimously adopted the recommendations.

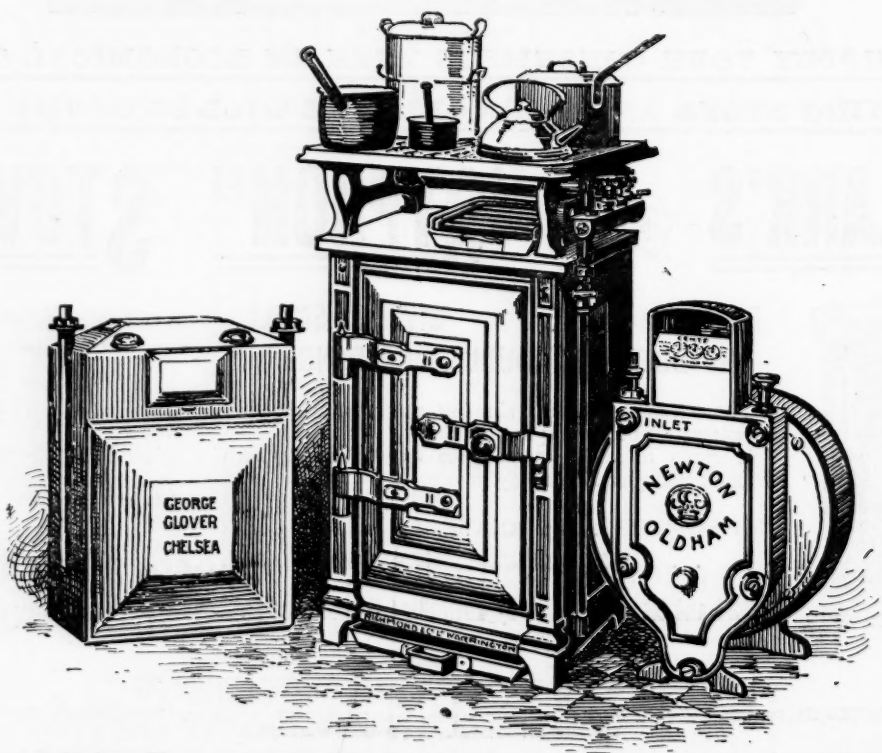
There was very little other business before the Commissioners. Mr. D. Purves, the Convenor of the Works Committee, reported that all the works belonging to them had received their summer overhaul, and everything was in a fair state for taking up the winter load. At Granton things were going on most satisfactorily. During the month of May, they had an increase in the manufacture of gas of nearly 3½ million cubic feet. They had had a discussion in Committee that day on the subject of the improvement of the street lighting by the use of other lanterns and burners, and also by incandescent gas lighting; and they had asked the Engineer (Mr. W. R. Herring, M.Inst.C.E.) to print his report upon it. They would meet to discuss this in time for whatever action might be taken in the winter.

At a meeting of the Arbroath Town Council on Monday, the Gas Committee reported that the Gas Manager (Mr. Alex. C. Young) had reported to them that the quantity of gas manufactured during the year ending May 15 was 70,768,200 cubic feet—an increase upon the preceding year of 2,796,400 cubic feet, equal to 4·11 per cent.; and that the quantity of gas sold during the year was 64,588,862 cubic feet—an increase of 4,149,168 cubic feet, equal to 6·8 per cent. Allowing for gas used in the works, amounting to 677,891 cubic feet, there remained unaccounted for 5,501,447 cubic feet, equivalent to 7·7 per cent. In the previous year, the unaccounted for gas was 9·8 per cent.; so that there had been the large decrease of 2·1 per cent. The gas made per ton of coal carbonized was 9363 cubic feet—an increase over the previous year of 274 cubic feet. The gas sold per ton of coal showed an increase of 466 cubic feet. They had put in 322 new and 24 second-hand gas-cookers to prepayment meters during the year, and 148 on the hire-purchase system had been fixed since the date of the exhibition last summer. The average increased consumption from cookers might be taken as: Prepayment cookers, 1056 cubic feet; hire-purchase cookers, 3850 cubic feet. The Manager, however, anticipates a larger increase in the consumption of gas by this means when the Council are in a position to make a reduction in the price. He estimates that the total increase in the quantity of gas sold was distributed thus: Prepayment meters, 2,600,300 cubic feet; hire-purchase cookers, 757,850 cubic feet; one large consumer, 228,000 cubic feet; and from ordinary meters and new cookers, 745,018 cubic feet. The average consumption of gas through ordinary meters was 11,300 cubic feet, against 11,044 cubic feet in the previous year—an average increase of 256 cubic feet, equivalent, at the current price of gas, to 1s. 1d. After deducting the extra gas consumed by the new cookers, the average consumption for each consumer was 11,144 cubic feet, as compared with 11,044 cubic feet in the previous year. The number of consumers was as follows: Ordinary meters, 5161; prepayment meters, 1043—total, 6204. The average consumption of gas paid for by coin meters was 6116 cubic feet. The Gas Committee expressed their satisfaction with the Manager's report, and with the statistics furnished by him. The Town Council also approved of the report.

Mr. Cuthbert, the Convener of the Gas Committee of the Perth Town Council, at a meeting of the Council on Thursday, said that the report of the Auditor upon the gas and electricity accounts had not been received; and he moved that consideration of the accounts be delayed till a future meeting. He took the opportunity of referring to a misleading report to the effect that there was a deficiency in the gas accounts for the past year. He said they had had, on the contrary, a very satisfactory year; and there was a small balance in hand.

At the meeting of the Dumfries Town Council last week, Bailie Houston proposed that an expert be appointed to report on the working at the gas-works, so that they might take into consideration whether they were doing the best they could. He meant by an "expert" a manager of works similar to their own, or larger, who could produce gas very much cheaper than they were doing, and was able to pay a bigger dividend than they were. This might not suit the Convener and the Committee, who appeared to be perfectly satisfied at present; and it might not injure the Manager at all, because he might come out with flying colours. The Council discussed the suggestion; the remarks disclosing the fact that the proposed inquiry was most objected to by the Committee, the Convener of which—Mr. Currie—protested that it was directed against himself. In the end the Council did not agree to the proposal, but sent it to the Gas Committee for a report. Now, to treat the proposal on its merits, there are only fourteen places in Scotland where the output of gas is larger than in Dumfries; but so

A TRIPLE ALLIANCE!



ADVERTISEMENT OF THE RICHMOND GAS STOVE AND METER COMPANY, LIMITED.

many of these are so manifestly dissimilar to what exists at Dumfries, that the choice of managers who would answer the requirements Bailie Houston mentioned is very limited indeed. Of course, a suitable man will be easily found; and if the Council are prepared to pay for his services, there is no reason why they should not get the opinion as to whether or not they are conducting their works properly. The Council have had a claim intimated to them on behalf of Messrs. R. W. Goold and Co., of Carlisle, for satisfaction to them on account of their not being invited to tender for the tar and liquor produced in the gas-works. They allege that the Manager at Dumfries undertook to furnish them with a copy of the advertisement calling for tenders, but did not do so; and the claimants interpret this as a breach of contract. They do not name a sum; but ask the Council to state what proposition they are prepared to make. The Town Clerk was directed to repudiate the claim. There is another branch to the subject, in some remarks which were made at the Council meeting on the 7th ult., in which the sincerity of their offer was called in question. The claimants maintain that their offer was seriously made, and say that they are dealing with the remarks independently. This points to the possibility of litigation over the matter.

The principal subject connected with the gas undertaking which has been before the Hamilton Town Council this week was a proposal by the Gas Committee to have themselves appointed as a deputation to visit Belgium to inspect and report upon stoking machinery. The proposal was opposed in the Council; some of the members treating it as a joke, and one expressing the opinion that if the thing were good, they would have an opportunity of seeing it nearer home than Belgium. The Council did not reject the proposal, but by seven votes to six sent it back to the Gas Committee for reconsideration.

During the past year, the manufacture of gas in the Corporation Gas-Works at Denny amounted to 11,239,100 cubic feet—an increase of 278,300 cubic feet over the quantity made the preceding year. Provost Hunter explained to the Town Council that they were likely to be left with surplus gas plant on their hands, on account of mills being now lighted by electricity. They had already lost one such customer, who paid them £600 a year for gas. The Gas Committee proposed, in order to keep up the consumption of gas, to reduce the price of it from 4s. 7d. to 3s. 9d. per 1000 cubic feet for lighting, and from 4s. 2d. to 3s. 4d. for power and heating purposes; and also to make an endeavour to extend the use of gas-cookers. They have made an arrangement with Messrs. R. & A. Main, Limited, for canvassing the district; and the Commissioners offer to supply and fit up a gas-griller free of charge. These proposals were adopted by the Council.

In the Kilsyth Corporation Gas-Works during the past year the quantity of gas manufactured amounted to 20,595,000 cubic feet—an increase of 1,129,200 cubic feet over the previous year. There had been an average yield of gas per ton of coal of over 10,000 cubic feet.

The Directors of the Linlithgow Gas Company have reduced the price of gas from 4s. 2d. to 3s. 9d. per 1000 cubic feet. The Directors of the Stirling Gas Company have reduced the price from 3s. 4d. to 3s. per 1000 cubic feet.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *June* 13.

Sulphate of Ammonia.

Supplies are still scarce in Scotland, and in that quarter extreme prices continue to be paid. Elsewhere the demand has been sufficient to sustain the market, and for prompt delivery the quotations are £12 13s. 9d. per ton f.o.b. Hull, and £12 16s. 3d. to £12 17s. 6d. per on f.o.b. Liverpool. £13 per ton is quoted f.o.b. Leith. For delivery over the month, however, the above prices are scarcely obtainable. In the forward position there has been increased interest, and up to £12 10s. per ton f.o.b. Leith is reported to have been paid for October-March delivery. For July-December, makers continue to quote £12 15s. per ton; but the Continental manufacturers are accepting considerably below the equivalent of that price, and are booking the Continental orders.

Nitrate of Soda.

This is firm in all positions, and spot prices remain 9s. 4½d. and 9s. 7½d. per cwt. for ordinary and refined qualities respectively.

LONDON, *June* 13.

Tar Products.

All the markets are decidedly quiet, and there is scarcely any business to report. Pitch is easier, especially for forward delivery, several of the large distillers being evidently anxious to place their make forward in consequence of having secured their tar at high prices. The South Wales demand is not so brisk as it was a week ago; while Continental buyers do not appear to take any interest in the article. 50-90 per cent. benzol has again been sold at 7d. for early delivery; while a small parcel of 90 per cent. has been placed at 8¼d. for export. Solvent and toluol remain unchanged. Crude carbolic is rather easier, one or two large sales having been made at 1s. 6d. prompt, which is a decided reduction on the prices recently ruling. Makers, however, still decline to sell for forward delivery, except at prices considerably over those at present ruling. Creosote is dull with an absence of demand, especially in the provinces, where stocks are accumulating. In anthracene, business is still limited to small quantities for prompt delivery. The price remains unchanged. Naphthalene has decidedly improved; and there is more inquiry from the Continent for forward delivery. As regards tar, the prices obtained in the provinces continue to be very high and largely in excess of the actual value as compared to the prices of products.

The average values during the week were: Tar, 22s. to 32s.; pitch, London, 56s. to 56s. 6d.; east coast, 53s. to 53s. 6d.; west coast, 52s. to 52s. 6d. Benzol, 90 per cent., 8¼d. to 8¾d.; 50-90 per cent., 7d. Toluol, 7d. Crude naphtha, 3d.; solvent naphtha, 7½d. to 8½d.; heavy naphtha, 9d. Creosote, London, 1¼d. to 1⅜d.; North, 1⅛d. to 1¼d.

THE

MAXIM PATENT CARBURETTOR

FOR ENRICHING GAS IN BULK.

PREVENTS NAPHTHALENE DEPOSITS.

OVER **100** MAXIM PATENT CARBURETTORS HAVE NOW BEEN FIXED.

Among the Companies and Towns supplied are The Gas Light and Coke Company, The South Metropolitan Gas Company, Birmingham, Leeds, Rochdale, Bristol, Sheffield, Southport, Alloa, Broughty Ferry, Dunfermline, and many other Works, both large and small, where they have been working in some instances for the past Seven Years.

MORE GAS & SALEABLE COKE PER TON of COAL CARBONIZED is PRODUCED; SAVING CAPITAL, LABOUR, FUEL, WEAR & TEAR, &c.

THE ENRICHMENT IS INSTANTANEOUS AND PERMANENT.

The Carburettor is inexpensive, easily fixed, and entirely supersedes the use of Cannel.

Dealers in Benzol, Carburine, and all other Naphthas and Oils suitable for the Enrichment or Production of Gas.

For Prices and full Particulars, apply to

THE GAS LIGHTING IMPROVEMENT COMPANY, LIMITED,

18, DEVONSHIRE STREET, BISHOPSGATE, LONDON, E.C.

Heavy oils, 2d. Carbolic acid, 60 per cent., 1s. 6d. to 1s. 6¼d. Refined naphthalene, £5 to £9; salts, 21s. 6d. to 23s. Anthracene, "A" quality, 1¾d. to 1¼d.; "B" quality, 1d. nominal.

Sulphate of Ammonia.

The market continues firm, and there is a very good demand, but principally for shipment from London. Beckton are still asking £12 17s. 6d. for June-July; but have not yet been able to realize this price. Another London Gas Company have, however, obtained this figure on their own special terms, and now ask £13 in any position. In Leith, the position remains the same. Business is reported at £12 17s. 6d. for prompt; but a very large business was advised as having been arranged for October-March at prices varying from £12 5s. to £12 10s. In Hull, the market is a little easier. Sales are reported at from £12 12s. 6d. to £12 13s. 9d. for prompt; and makers ask the same price for July shipment. In Liverpool, there is more inquiry for both prompt and forward delivery. The market closes decidedly firm, with an improved demand for forward delivery.

COAL TRADE REPORTS.

Lancashire Coal Trade.

Following the resumption of operations after the holidays, a general quietude is coming over the coal trade of this district; and notwithstanding the large restriction of output during Whitsuntide, it has already been found necessary in many cases to put pits on short time. Prices, except that where here and there special lots of surplus output have to be pushed on the market for immediate sale, show no very material change. Although the better qualities of round coal are just now in the smallest possible demand for house-fire purposes, reductions in price would at this time of the year scarcely stimulate any appreciable increased weight of buying, and collieries prefer either to run short time or put down to stock rather than attempt to force business by reducing prices. Special lots, of course, can occasionally be picked up at under current rates; but the general quotations remain fairly steady at about 14s. to 15s. per ton for the best Wigan Arley coals, 11s. 6d. up to 12s. 6d. for seconds Arley and Pemberton four feet, and about 10s. to 10s. 6d. for the commoner qualities. The lower descriptions of round coal continue only in moderate inland request. Prices tend to weaken where anything like quantities are upon the market for competition, and 8s. to 8s. 3d. per ton at the pit would represent about the figures that are being taken for the common sorts of steam and forge coals, with better qualities quoted about 8s. 6d. to 8s. 9d. With regard to gas coals, further contracts have been settled during the past week or so, and these have generally been on the basis of about 6d. below last year's contract prices. The bulk of the railway contracts have now been settled at about 3d. under the rates paid last year. This represents a basis for the present year's gas coal contracts of from 8s. 3d. to 8s. 9½d. and 9s. per ton at the pit for ordinary screened Wigan four feet, about 9s. 3d. and 9s. 6d. up to 9s. 9d. and 10s. per ton for the best Wigan screened Arley gas coals, and 7s. 9d. to 8s. per ton in some cases as the general average for locomotive classes of fuel. Steam coals are in fair request for shipment, but only at low figures, averaging 9s. 3d. to 9s. 6d. per ton for special sales up to 9s. 9d. and 10s. quoted for the better qualities delivered at the ports on the Mersey. Engine classes of fuel continue plentiful on the market, but without any really quotable change upon the prices last given; common slacks averaging 4s. 3d. and 4s. 6d. up to 4s. 9d., medium sorts 5s. and 5s. 3d. up to 5s. 9d., and best slacks 6s. 6d. to 6s. 9d. up to 7s. for special qualities at the pit mouth.

Northern Coal Trade.

There is a steady demand for coal, both steam and gas qualities, and the produce of the pits seems to be generally well taken up, though there is not any great pressure in the demand. In the steam coal trade, there are now very heavy exports to the Baltic ports. Best Northumberland steam coals are steady at from 10s. 7d½. to 10s. 9d. per ton, and second-class steams are 8s. 9d. to 9s. 3d. per ton, both free on board; while steam smalls are 5s. 9d. to 5s. 10½d. per ton. In the gas coal trade, deliveries for home consumption are moderate in amount; but there are heavy exports at the present time, especially to the Baltic. The current quotation for Durham gas coals is from 8s. 6d. to 9s. per ton, free on board, for occasional cargoes, according to quality. There have been few contracts of note since the settling of those for the Newcastle Gas Company, for some 250,000 tons yearly, at a reduction of about 4d. to 5d per ton on the expiring contracts. The coke markets are firmer on the whole; and gas coke is steady at the prices last quoted for export, with an occasional advance at the inland towns, owing to the limited output of gas coke at the present time.

Scotch Coal Trade.

Quiet trade and prices barely maintained is the state of business in the coal market; but while that is so, coalmasters are not disposed to accept present prices for forward delivery. The prices quoted are: Main 8s. to 8s. 3d. per ton f.o.b. Glasgow, ell 8s. 6d. to 10s., and splint 9s. 3d. to 9s. 9d. The shipments for the week amounted to 216,291 tons—a decrease of 30,133 tons upon the preceding week, but an increase of 19,762 tons upon the corresponding week of last year. For the year to date, the total shipments have been 4,419,744 tons—an increase of 177,695 tons upon the same period of last year.

Reductions in Price.—The Directors of the Beccles Gas Company have decided to reduce the price of gas to 4s. 2d. per 1000 cubic feet, as from April 1 last. The Leigh Town Council have resolved to lower the price of gas from 3s. 3d. to 3s. 1d. per 1000 cubic feet, in spite of the fact that the proposal was opposed by Alderman Cowburn, the Chairman of the Gas Committee.

CARBURETTED WATER-GAS APPARATUS

Merrifield—Westcott—Pearson Patents.

The Economical Gas Apparatus Construction Co., Ld.

W. H. PEARSON, Chairman.
W. H. PEARSON, Junr., Deputy-Chairman.
J. T. WESTCOTT, M.E., Manager.
L. L. MERRIFIELD, M.Inst.M.E., Engineer.

London Offices: 19, ABINGDON STREET, WESTMINSTER, S.W.
American Offices: TORONTO. TELEGRAPHIC ADDRESS: "CARBURETED, LONDON."

CARBURETTED WATER-GAS ENGINEERS.

The above Company have erected since 1893, or are now erecting, their Universal Type of Carburetted Water-Gas Plant at the following Gas-Works:—

	Cub. Ft. Daily.		Cub. Ft. Daily.		Cub. Ft. Daily.
BLACKBURN	1,250,000	ST. CATHERINES (Remodelled)	250,000	ACCRINGTON	500,000
WINDSOR ST. WORKS, BIRMINGHAM	2,000,000	KINGSTON, PA.	125,000	TONBRIDGE	300,000
SALTLEY WORKS, BIRMINGHAM	2,000,000	PETERBOROUGH, ONT.	250,000	STRETFORD	500,000
COLCHESTER	300,000	WILKESBARRE, PA.	750,000	OLDBURY	300,000
BIRKENHEAD	2,250,000	ST. CATHERINES (Second Contract)	250,000	TODMORDEN	500,000
SWINDON (New Swindon Gas Co.)	120,000	BUFFALO, N.Y.	2,000,000	SALTLEY, BIRMINGHAM (Third Contract)	2,000,000
SALTLEY, BIRMINGHAM (Second Contract)	2,000,000	WINNIPEG, MAN.	500,000	YORK (Second Contract)	750,000
WINDSOR ST., BIRMINGHAM (Second Contract)	2,000,000	COLCHESTER (Second Contract)	300,000	ROCHESTER (Second Contract)	500,000
HALIFAX	1,000,000	YORK	750,000	NEWPORT (MON.)	250,000
TORONTO	250,000	ROCHESTER	500,000	TOKIO, JAPAN	1,000,000
OTTAWA	250,000	KINGSTON, ONT.	300,000	PERNAMBUCO (Brazil)	125,000
LINDSAY (Remodelled	25,000	CRYSTAL PALACE DISTRICT	2,000,000	MALTON	150,000
MONTREAL	500,000	DULUTH, MINN.	300,000	DULUTH, MINN. (Second Contract)	300,000
TORONTO (Second Contract Remodelled)	2,000,000	CATERHAM	150,000	BROCKVILLE (ONT.)	250,000
BELLEVILLE	250,000	LEICESTER	2,000,000	SMETHWICK	500,000
OTTAWA (Second Contract)	250,000	ENSCHEDE (HOLLAND)	150,000	GRAVESEND	300,000
BRANTFORD (Remodelled)	200,000	BUENOS AYRES (RIVER PLATE CO.)	700,000	NEWPORT MON. (Second Contract)	250,000
		BURNLEY	1,500,000	TORONTO (Third Contract)	750,000
		KINGSTON-ON-THAMES	1,750,000	TORONTO (Fourth Contract)	1,000,000

Complete Gas-Works at NELSON, BRITISH COLUMBIA.

LEEDS, 1,800,000 C. Ft. LEICESTER (2nd Cont.), 1,000,000 C. Ft. NEWCASTLE-ON-TYNE, 1,800,000 C. Ft.
MONTREAL, ONT. (Second Contract) . . . . . 1,800,000 Cub. Ft.

The Fatal Accident at Kennington Oval.—Last Wednesday, Mr. Troutbeck, the Coroner for Lambeth, resumed the inquiry in regard to the deaths of Aspinal Shaw and Thomas Morrell, at the Kennington Oval station of the South Metropolitan Gas Company on the 26th ult. (*ante*, p. 610). The result was a verdict of "Accidental death, due to a faulty crab."

Electrolysis at Leeds.—The Leeds Tramways Committee have decided to make exhaustive experiments with a view to finding out the exact extent of the injury which is being caused to the gas and water pipes of the city by the escaping electric current; and arrangements have been made to give immediate attention to any complaints received from the Gas Committee. It is hoped, however, that the damage may not prove to be so serious as was at first anticipated.

Reduction in the Price of Gas at Widnes.—At the meeting of the Widnes Town Council last Tuesday, the price of gas was reduced as follows: To ordinary consumers of 3 million cubic feet and upwards per annum, from 1s. 3d. to 1s. 2d. per 1000 cubic feet; to consumers of less than 3 millions per annum, from 1s. 5d. to 1s. 4d.; and to consumers for motive power purposes, from 1s. 6d. to 1s. 1d.; the quantity of gas supplied per slot meter to be increased from 38 to 40 cubic feet for a penny. A reduction was also made of 1d. per 1000 cubic feet all round to consumers outside the borough.

Improved Results at Loughborough.—Mr. E. Onions, the Manager of the Loughborough Gas-Works, was highly complimented by the Chairman of the Gas Committee and other members of the Town Council at their last meeting on the working of the department during the past year. There was an increase of 6¼ per cent. in the consumption of gas; and a gross profit of £6162 was realized. To set against this, however, there was a sum of £6395 for payment to sinking fund and interest—leaving a deficit of £233. This result was very much better than had been anticipated; and as the undertaking will be shortly relieved of a charge of £610 a year, it is expected that a net profit will soon be shown on the working, and further reductions in price be made to the consumers.

St. Helens Gas Supply.—At the last monthly meeting of the St. Helens Town Council, Mr. W. L. Shaw, in moving the adoption of the minutes of the Gas and Lighting Committee, drew the attention of the members to the success which had attended the efforts of the Committee and the Manager (Mr. S. Glover) during the past financial year; there being a net profit of £9250, which the Committee proposed to appropriate as follows: To the borough fund, £3500; to the capital account, for extensions of mains and services, £1949; to the suspense account, for payment of the interest and sinking funds at the new gas-works, £1468; and to the reserve fund, £2133. There had been an increase of more than 5 per cent. on the quantity of gas made during the year; in the total number of consumers, there was a rise of 965. The amount of cash collected from the coin-meters was £11,715, or 2,811,631 coins. Mr. Shaw added that the Committee were in an unfortunate position owing to the illness of Mr. Glover, to whom they had granted leave of absence for three months. The minutes were confirmed.

Sales of Shares.—At the Mart, Tokenhouse Yard, E.C., last Tuesday, Mr. Alfred Richards sold, by order of the Directors, a further issue of £10,000 of new 5 per cent. ordinary stock, entitled, in view of the dividends paid on the existing stocks of the Company for the last 18 months, to a dividend at the rate of £6 1s. per cent. per annum. It realized an average of £123 4s. 9d. per £100 of stock. On the same occasion, he sold some £10 "B" shares in the Bournemouth Gas and Water Company, carrying a dividend of 7 per cent., at £17 10s. each. Some original stock of the Brighton and Hove Gas Company (last dividend 10¾ per cent.) fetched £214 and £215 per £100. Barnet Gas and Water Company's "C" stock realized £170 and £171, and "D" stock £108 10s. per £100; while allotments at par of £1513 of the last-named stock (last dividend £5 5s. per cent. per annum) were sold at premiums ranging from £5 10s. to £9 per £100. Last week, Mr. J. W. Crosby sold by auction £5000 worth of 5 per cent. maximum ordinary stock in the Hartlepool Gas and Water Company at prices ranging from £123 to £123 5s. per £100 of stock.

Water-Meters in America.—The report of the Taunton (Mass.) Water Department for last year contains some interesting statements about water-meters. There are 2050 meters in use, and the department has had in all 3340 meters of 27 different kinds, of which 1290, after a longer or shorter period of use, have been rejected. In the past ten years, 13,098 tests of meters were made, the average of which showed an error slightly in favour of the consumer. The evidence seems conclusive that, on the whole, meters, when properly cared for, are fair and equitable in their record, both to the supplier and the consumer, with a general leaning in favour of the latter. The metered water consumption in Yonkers (N.Y.) affords a particularly interesting subject of study, because practically every service-pipe in the city is metered. The total quantity pumped last year was about 1330 million gallons, measured by plunger displacement without any deductions; while the quantity metered was only 56·2 per cent. of this figure. Hence the street-main leakage, and the slip in the pumps and the meters, must have amounted to about 44 per cent. of the water nominally furnished.

Margate New Water Scheme.—Last Tuesday, the presence of Messrs. W. A. Valon and Son was required at a Local Government Board inquiry by Colonel Langton Coke, M.Inst.C.E., at Minster; hence their absence from the meeting of the Institution in London. The inquiry related to an application made jointly by the Thanet and the Eastry Rural District Councils for power to borrow a further sum of £1947 for the completion of the construction of a new road from Monkton to Stourmouth. This road is part of the scheme connected with the bridge which has been constructed over the Stour, and for which Messrs. Valon were the Engineers. One of the purposes of the bridge is the carrying over the river of the trunk pipes connected with the new water scheme for Margate. The evidence given at the inquiry was purely of a financial character, excepting in one respect, and that was when Mr. W. A. Valon told the Inspector that the bridge had been given a very severe test, with three trucks (each loaded with 15 tons of stone), drawn by a traction engine, 18¾ tons gross. The test instruments showed practically no oscillation. The bridge has been taken over by the Kent County Council.

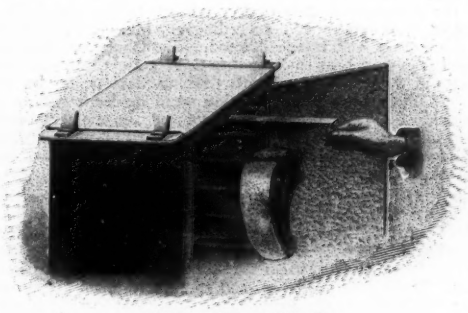
THREE SPECIAL FEATURES

OF

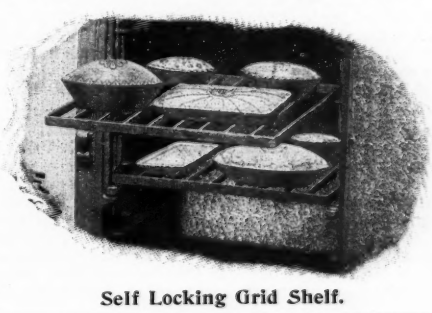
PARKINSON'S

"CROWN"

COOKER.



Sliding Meat Hook.



Self Locking Grid Shelf.

Adjustable Grid for Grill.

PARKINSON AND W. & B. COWAN, LTD.

(PARKINSON BRANCH),

LONDON AND BIRMINGHAM.

Intensified Gas Lighting in the Bury Market.—From a statement made by Mr. L. Fletcher, the Chairman of the Bury (Lancs) Corporation Gas Committee, at the last meeting of the Town Council, the experiment tried by the Committee in utilizing intensified gas for the illumination of the new public Market Hall has been attended with gratifying success. He pointed out that the cost from Oct. 1, 1902, to March 31, 1902, had been as follows: Gas consumed, 483,200 cubic feet, £46 6s. 2d.; water, £6 14s. 9d.; mantles, £5 4s.—total £58 4s. 11d. During the year there had been in use 80 lights, of 350-candle power each, burning 596 hours. The average cost per hour for 28,000-candle power had been 1s. 11·85d., or a fraction over ¾d. per hour per 1000-candle power.

Satisfactory Working at Ossett.—The minutes of the Gas Committee which were presented at the last meeting of the Ossett Town Council contained a satisfactory report by the Gas Manager (Mr. A. E. Mottram). It showed that in the twelve months to March last 959 new consumers were added, and 10,373 yards of mains laid, chiefly in places outside the borough. The standing charges for interest and sinking fund were now just over £6000 per annum, against the late Gas Company's charges of a little more than £4000. In working results, however, this difference had been more than made up. They had used 803 tons less coal, made 1051 cubic feet more gas per ton, increased the sale by nearly 5,250,000 cubic feet, and reduced the leakage—these items showing a total saving of £2150.

Welsbach Incandescent Gas-Light Company, Limited.—An extraordinary general meeting of the Welsbach Incandescent Gas-Light Company was held on Thursday, at the offices, at Palmer Street, Westminster. Mr. Edgar Williamson presided, and explained that they had met to confirm the resolutions with regard to the alterations in the Articles of Association agreed to on the 27th ult. (*ante*, p. 598), and he moved accordingly. Mr. J. T. Brinsmead seconded the motion, and it was adopted. The Chairman then stated that the next step would be to go to the Courts for their sanction of the reduction in the capital, and said that no time would be lost in doing so. Should there be no opposition—and he did not think there would be any of a serious nature—he trusted the matter would be quickly disposed of. When they were once again in receipt of dividends, he hoped that they would be able to forget what had been a most unfortunate past.

Gainsborough Gas Supply.—In presenting at the last meeting of the Gainsborough Urban District Council a report on the gas undertaking, Mr. Housham, the Chairman of the Gas Committee, remarked that the works had not proved to be the "white elephant" some people suggested; and he could tell them that they would never be a burden to the rates. During the year, they had manufactured 76,555,000 cubic feet of gas; while the old Company made 64,287,000 cubic feet during the last year they had possession. The expenditure had been £8744; and the income from all sources was £13,238, which left a profit of £4494. From this they must deduct the repayments of principal and interest and sinking fund (£4300), leaving a net profit of £193. In addition to this, they had spent £1087 in repairs, &c. The increase in the consumption since the Council took over the works had been very great. The concern was undoubtedly a good one; but it would require careful watching for years ere they were in easy circumstances.

Bury Corporation Gas Undertaking.—Some interesting figures were laid before the last meeting of the Bury Town Council, by Mr. L. Fletcher, the Chairman of the Gas Committee. He stated that in 1858, when the gas-works were taken over by the Local Authority, the capital stood at £56,220. During the 45 years which had since elapsed, the following amounts had been expended on the works; Railway siding, £41,123; tar-works, £5517; show-rooms and offices for collecting purposes, £2659; other extensions, £174,055—making a total expenditure of new capital amounting to £223,354. The total capital expenditure was thus £279,574, of which amount £111,346 had been extinguished by sinking fund; leaving the present capital at £168,228. The daily producing power of the works in 1858 was 260,000 cubic feet; in 1902, it was 2,000,000 cubic feet—an increase of 680 per cent. There had been transferred from the gas revenue for the relief of the rates a sum of £99,011; and at the same time the price of gas had been brought down from 4s. 6d. per 1000 cubic feet net to 1s. 11d. for lighting and 1s. 9d. for motive power.

Burgess Hill Gas Company.—At the recent annual meeting of this Company, the Directors recommended the payment of a dividend of 6 per cent., free of income-tax, which would leave, out of the amount available for distribution as the result of the year's working, a sum of £258. The Chairman (Mr. W. Wood) moved the adoption of the report and accounts, which he hoped would be considered satisfactory. Mr. Maynard seconded the motion. Mr. Worthington Church called attention to the difference between the quantity of gas made per ton of coal carbonized and that sold, amounting to the large difference of 16½ per cent., and said that in a place like Burgess Hill it ought not to average more than 6 or 7 per cent. He also pointed out that, according to the balance-sheet, only 3 cwt. of coke per ton of coal used was sold; whereas other companies sold 7 cwt. to the ton. He thought these points should be well considered by the Directors. The capital was in favour of the Company. If they sold 500 cubic feet more gas per ton of coal, they would be able to pay 1 per cent. more dividend and sell the gas 6d. per 1000 cubic feet cheaper. At Cranleigh they were selling 10,000 cubic feet to the ton, whereas at Burgess Hill it was only 8300 cubic feet. He thought the ammoniacal liquor ought to be converted into sulphate of ammonia, for which they would be receiving from £100 to £120, against practically nothing. Mr. Maynard said with more capital in hand improvement could be effected in the sale of gas. Mr. Burt apprehended that sulphate works would be a nuisance at Burgess Hill. Mr. Church said if the gas-works were his he would put down sulphate plant without hesitation. The Chairman remarked that for weeks past they had been making over 11,000 cubic feet of gas per ton of coal. The difference in the make and the sale might be met by renewing the machinery, thus producing better results in the carbonization. If the Directors got more money, they would do what would ease Mr. Church and others. The report and accounts were adopted.

IMPORTANT.

IF

YOU WANT QUICK DISPATCH

send all orders for

SLOT INSTALLATION FITTINGS,

PENDANTS,

BRACKETS,

INVERTED FITTINGS,

MAIN COCKS

(OF EVERY DESCRIPTION)

SYPHON AND LUBRICATOR PUMPS

TO

WILLEY & CO.,

LONDON and EXETER.

Quotations cheerfully given for all kinds of Gas Fittings.

Peterborough Water Supply.—Some hitch having arisen in connection with the proposed auxiliary water supply for the city of Peterborough, which it was contemplated to take from Etton, a distance of about six miles, the Town Council thought it necessary, owing to a report by the Medical Officer of Health, to have the water again analyzed. This was done, and the result fully confirms the analyses of Mr. W. Elborne, the City Analyst, that it is a water well adapted for all domestic purposes. The Council have therefore decided to proceed with the scheme: but, before arriving at definite plans, they have appointed a Committee to inspect similar works now in hand. The scheme will, it is understood, cost about £30,000.

Winding Up the Exmouth Water-Works Company.—A meeting of the Exmouth Water-Works Company was held on the 28th ult. to wind up the affairs of the Company, whose undertaking has been purchased by the District Council. The Rev. C. R. Carr, who presided, said the shareholders had reason to congratulate themselves on the result of the sale; but he warned the Council that they ought to lose no time in making provision for the increased storage which the Company had intended to carry out. A report which was presented showed that £30 had been paid on the 10 per cent. shares, £20 on the 7 per cent. shares, and £15 on the 5 per cent. shares, and that a balance of £59 remained. It was decided to hand this to the Secretary (Mr. H. C. Adams).

Metropolitan Water Board.—At the ordinary meeting of the Board on Friday, the Finance Committee presented a report on the draft regulations, prepared by the Local Government Board, under the provisions of sections 17 and 18 of the Metropolis Water Act, 1902, with respect to the stock which the Board are authorized to create and issue. The regulations are to be considered at a special meeting next Friday. The General Purposes Committee reported that they had again considered the application of candidates for the appointment of Clerk; and they submitted the following names: Mr. A. B. Bryceson, Town Clerk of Woolwich; Mr. W. F. Craies, barrister-at-law and a member of the Kensington Borough Council; and Mr. A. B. Pilling, the Town Clerk of Devonport. The last-named gentleman was eventually appointed.

Water Scheme for West Cumberland.—At a meeting a short time ago of the Whitehaven Rural District Council, the Chairman (the Rev. W. G. C. Hodgson) moved the adoption of a report of the Water Committee recommending the carrying out of a scheme to supply the whole of the southern district with water at an estimated cost of £13,820, and involving a rate of 1s. in the pound over the district. He pointed out that this scheme was identical with the one passed by the Council in December last, with the exception of the source of supply. Miss Ponsonby's terms were prohibitory, as she required 6d. per 1000 gallons. Negotiations were opened in other directions; and they now proposed to take the water from two springs belonging to Lord Leconfield. This would involve, as compared with the previous scheme, an additional expenditure of £700. The report was adopted by eight votes to two.

Devonport Corporation and the Water-Works.—In connection with the arbitration proceedings for the transfer of the Devonport waterworks to the Corporation, it has been agreed that the Corporation shall pay the following annuities to officials of the Company: Mr. Foster J. Bone, the Secretary, £210; Mr. H. Francis, the Engineer and Manager, £400; Mr. W. Parr, ledger clerk, £60. At the instance of the Corporation, it has been directed that the Arbitrators' award shall be made in the form of a special case, in order that the opinion of the High Court may be obtained on these points: (1) As to the extent of the liability of the undertakers to supply water to the Admiralty under the Company's Act of 1793; (2) as to the right of the Company to claim back-dividends; and (3) as to their right to pay an additional 1 per cent. on the 4 per cent. preference stock. According to an affadavit filed by the Town Clerk of Devonport, the question of value involved in the determination of these three points is £90,000. In view of this, the Company have asked that the arbitration may be reopened, on the ground that the determination of the question of the liability to supply the Admiralty involves a number of issues of fact in regard to which the whole of the available evidence was not before the Arbitrators. The Company deny that the value involved in the three points in dispute is as high as the Town Clerk states.

APPLICATIONS FOR LETTERS PATENT.

12,477.—Maréchal, L., and Barrière, P., "Gas producers." June 2.
12,506.—La Société Française de Constructions Mécaniques, "Gas-producers." June 2.
12,565.—Arnold, E. E., "Gas-engines." June 3.
12,587.—Bordier, A. A., "Incandescent gas-lamps." June 3.
12,593.—M'Quinn, J. T., "Illuminant appliance for gas-burners." June 4.
12,594.—M'Quinn, J. T., "Burner for use with incandescent mantles." June 4.
12,664.—Rowbotham, W, "Gas and like engines." June 5.
12,685.—Purrott, A. E., and Willard, E. W., "Acetylene lamps." June 5.
12,691.—Leonard, E. G., and Hughes, P. C., "Burners for incandescent and ordinary lighting." June 5.
12,696.—Oppenheimer, W., and Kent, T. O., "Treating tar for the elimination of water and recovery of volatile products therefrom." June 5.
12,716.—Bergner, H., "Gas-igniting device." June 5.
12,770.—Piper, O., "Meters." June 6.
12,801.—Compagnie Anonyme Continentale pour la Fabrication des Compteurs a Gaz et Autres Appareils—"Meters." June 6.

"THE MAIN"

NEW SERIES

SLOT COOKERS

In 4 Sizes,

WITH FIXED OR LOOSE BURNERS

AS DESIRED.

The Best on the Market.

R. & A. MAIN, LTD.,

LONDON, GLASGOW, BIRMINGHAM,

MANCHESTER, BRISTOL.

Factories: LONDON AND FALKIRK.

Defective Reservoir at Teignmouth.—It was reported to the Teignmouth District Council recently that the No. 2 reservoir, which was constructed a few years ago, had been emptied, and was found to be cracked all over the floor and sides. Some of the cracks were $\frac{3}{16}$ inch wide; and water from No. 1 reservoir was bubbling up through the floor of No. 2 like a number of small fountains. The Surveyor said he would not pronounce the reservoir useless, but it was certainly in an extraordinary condition. It was decided that the Council should inspect the reservoir before considering any action in reference to it.

Increased Capital for the Dorking Water Company.—At an extraordinary general meeting of the Dorking Water Company recently held, authority was given to the Directors to raise fresh capital to the amount of £8000, by the creation and issue of ordinary shares bearing a maximum dividend of 7 per cent. The Chairman (Mr. Barclay) stated that, owing to the increase of Dorking, a much larger supply of water was required; and as their Deepdene well did not prove satisfactory, they were compelled to look elsewhere. A place had been found were there was an overflow of 187,000 gallons a day; and this would meet the needs of Dorking for some years.

An exhibition of the appliances of Messrs. John Wright and Eagle Range was held in the Albert Hall, Stirling, last week, at which Miss M. B. Terrace was the lecturer.

Mr. Bertram Blount, consequent on the death of his partner, (Mr. W. H. Stanger), has removed to Nos. 76-78 York Street, Westminster, where he will continue in practice under his own name.

The Attleborough Gas Company has been registered with a capital of £5000, in £1 shares, to acquire, on the terms of an agreement dated April 14, 1903, between H. Hill and W. Dilworth (for the Company), the freehold gas-works and other property and effects at Attleborough, Norfolk; to produce, sell, and supply gas, electric, or other light in or near Attleborough; to manufacture and deal in coke, coal, tar, pitch, asphaltum, ammoniacal liquor, and other residual products &c. There will be no initial public issue.

The Richmond Gas Stove and Meter Company, Limited, have recently held important exhibitions at Ilford, Penzance, Redruth, Newtown, and Stone; and in conjunction therewith, cookery lectures have been given, and canvassing of the consumers has been undertaken.

The Chesterfield Gas and Water Board have placed with Messrs. Robert Dempster and Sons, Limited, of Elland, a repeat order for six arches of inclined retorts, each containing settings of seven, on the same principle as the first installation erected by the firm. They have also been entrusted with a contract for putting down the necessary foundations and erecting a 120 feet diameter steel tank and three-lift gasholder. The work is to be carried out under the supervision of Mr. W. T. Buckland, the Board's Engineer.

An exhibition of the stoves and cookers of the Davis Gas-Stove Company, Limited, and Messrs. Willey and Co. was opened last Tuesday at Devonport, under the auspices of the Gas Committee, who have adopted these appliances in connection with their stove-hiring scheme and automatic meter supply. Mr. W. Hornbrook, the Chairman of the Gas Committee, opened the exhibition, and, in connection with the municipal development of the town, claimed that the gas-works would prove the best undertaking they possessed. Miss Gurney gave cookery lectures.

The employees of Messrs. W. Sugg and Co., Limited, recently had a walking race to Brighton. The start was made from Big Ben at 12.4 a.m., and the pace was very good to Streatham. Just beyond Croydon a terrific thunderstorm was encountered, which caused some distress to the competitors; but they bravely struggled through the elements, and Redhill was reached in very good time. Crawley was entered at 5.30 a.m.; and thenceforward it was a splendid race. The following was the result: (1) Brewer, 11h. 30m.; (2) Lugsdin, jun., 11h. 57m.; (3) Devine, 12h. 35m.; (4) Pennington, 13h. 46m.; (5) Belcher, 14h. 26m.; and (6) Regan, 14h. 26m. Brewer had led nearly all the way, and finished fairly fresh. The judges on the road were Messrs. Daniels, Bond, Duffy, and Morgan; those at Brighton, Messrs. J. Fraser and T. Pelton.

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name an address of the writer; not necessarily for publication, but as a proof of good faith.

COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office NOT LATER than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or Stoppages of, PERMANENT ADVERTISEMENTS should be received by the FIRST POST on SATURDAY.

Wanted, For Sale, and Tender Advertisements, Six Lines and under 3s.; each additional Line, 6d.

TERMS OF SUBSCRIPTION to the "JOURNAL."

United Kingdom: One Year, 21s.; Half-Year, 10s. 6d.; Quarter, 6s. 6d. Payable in Advance. If credit is taken, the charge is 25s. a year.

Abroad (in the Postal Union): £1 5s. 6d., payable in Advance.

All Communications, Remittances, &c., to be addressed to WALTER KING, 11, BOLT COURT, FLEET STREET, LONDON, E.C.

Telegrams: "GASKING, LONDON." Telephone: P.O. 1571a Central

WANTED, FOR SALE, CONTRACT, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Situations Vacant.

CLERK. Long Eaton Gas-Works.
GENERAL FOREMAN. No. 4047.
LAMPLIGHTER, &c. Wells Gas-Works.
SLOT-METER INSPECTOR AND COLLECTOR. Long Eaton Gas-Works.
WORKING MANAGER. Atherstone Gas Company. June 22.

Situations Wanted.

CLERK, &c. No. 4033.
DRAUGHTSMAN OR REPRESENTATIVE, &c. No. 4046.
REPRESENTATIVE GAS ENGINEERING FIRM. No. 4045.
TRAVELLER GAS ENGINEERING FIRM. No. 4032.

Plant, &c., for Sale.

LANTERNS, CRADLES, TAPS, &c. Islington Corporation. June 24.
PURIFIERS, &c. Leighton Buzzard Gas-Works.
PURIFIERS AND STATION GOVERNOR, &c. Walton Workhouse, Liverpool.
SCRUBBER, WASHER, STATION METER, EXHAUSTER, TANKS, CONDENSERS, MOUTHPIECES, LANTERNS, &c. Longwood Gas Company.
STATION METER. Cannock and Hednesford Gas-Works.

Sales of Stocks and Shares.

CROYDON GAS COMPANY. July 9.
GLOVER AND MAIN, LIMITED. No. 4049.
HARWICH GAS COMPANY. July 6.
NEWCASTLE AND GATESHEAD WATER COMPANY. July 21.
RUGBY GAS COMPANY. July 3.
SOUTH METROPOLITAN GAS COMPANY. June 23.
TENDRING HUNDRED WATER COMPANY. July 6.

TENDERS FOR

Benzol.

DARWEN GAS DEPARTMENT. Tenders by June 27.

Brimstone.

HALIFAX GAS DEPARTMENT. Tenders by June 24.

Carbon.

HALIFAX GAS DEPARTMENT. Tenders by June 24.

Coal and Cannel.

BARNSTAPLE GAS COMPANY. Tenders by June 27.
BLACKPOOL GAS DEPARTMENT. Tenders by June 25.
BRADFORD GAS DEPARTMENT. Tenders by July 1.
CARDIFF GAS COMPANY. Tenders by June 25.
CARLISLE GAS DEPARTMENT. Tenders by June 30.
COLWYN BAY GAS DEPARTMENT. Tenders by June 24.
CONGLETON GAS DEPARTMENT. Tenders by June 20.
DUDLEY GAS COMPANY. Tenders by June 22.
DUKINFIELD GAS DEPARTMENT. Tenders by June 24.
ELLESMERE GAS DEPARTMENT Tenders by July 2.
GAINSBOROUGH GAS DEPARTMENT. Tenders by June 23.
HAWORTH GAS DEPARTMENT. Tenders by July 2.
HOLYHEAD, &c., GAS AND WATER COMPANY. Tenders by June 25.
LEEK GAS DEPARTMENT. Tenders by June 27.
LINCOLN GAS DEPARTMENT. Tenders by June 20.
MARKET HARBOROUGH GAS DEPARTMENT. Tenders by June 27.
NEWRY GAS DEPARTMENT. Tenders by June 19.
NOTTINGHAM WATER DEPARTMENT. Tenders by June 26.
RADCLIFFE AND PILKINGTON GAS COMPANY. Tenders by June 24.
ROCHESTER, &c., GAS COMPANY. Tenders by June 23.
RUTHIN GAS COMPANY. Tenders by June 25.
ST. ANNE'S-ON-SEA GAS DEPARTMENT. Tenders by June 25.
SMETHWICK GAS DEPARTMENT. Tenders by June 26.
SUTTON-IN-ASHFIELD GAS DEPARTMENT. Tenders by June 22.
TORQUAY GAS DEPARTMENT. Tenders by June 18.

Coke.

SUTTON-IN-ASHFIELD GAS DEPARTMENT. Tenders by June 22.

Fire-Clay Goods.

DARWEN GAS DEPARTMENT. Tenders by June 27.

General Stores, Lead, Taps, &c.

NOTTINGHAM WATER DEPARTMENT. Tenders by June 26.

Lamp Fittings, Brass Cocks, &c.

HALIFAX GAS DEPARTMENT. Tenders by June 24.

Lime.

CONGLETON GAS DEPARTMENT. Tenders by June 20.
HALIFAX GAS DEPARTMENT. Tenders by June 21.
SUTTON-IN-ASHFIELD GAS DEPARTMENT. Tenders by June 22.

Oxide of Iron (New and Spent).

HALIFAX GAS DEPARTMENT. Tenders by June 24.

Pipes and Fittings, &c.

CARDIFF GAS COMPANY. Tenders by June 25.
DARWEN GAS DEPARTMENT. Tenders by June 27.
GORING AND STREATLEY GAS AND WATER COMPANY. Tenders by June 26.
NOTTINGHAM WATER DEPARTMENT. Tenders by June 26.

Retort-House, &c. (Building).

BRITISH GASLIGHT COMPANY. Norwich. Tenders by June 22.

Retort Settings and Fittings.

COLWYN BAY GAS DEPARTMENT. Tenders by June 24.

Retorts.

DARWEN GAS DEPARTMENT. Tenders by June 27.

Sulphuric Acid.

HALIFAX GAS DEPARTMENT. Tenders by June 24.

Tar and Ammoniacal Liquor.

ATHERTON GAS DEPARTMEN Tenders by June 30.
CARLISLE GAS DEPARTMENT. Tenders by June 30.
KESWICK GAS COMPANY. Tenders by June 24.
LEEK GAS DEPARTMENT. Tenders by June 27.
OSWALDTWISTLE GAS DEPARTMENT. Tenders by June 29.
READING GAS COMPANY. Tenders by June 22.
SUTTON-IN-ASHFIELD GAS DEPARTMENT. Tenders by June 22.

Telephone Cable, &c.

GORING, &c., GAS AND WATER COMPANY. Tenders by June 26.

Valves, &c.

NOTTINGHAM WATER DEPARTMENT. Tenders by June 26.

ALL WHO ARE CONSIDERING THE ADOPTION

OF

WATER-GAS PLANTS

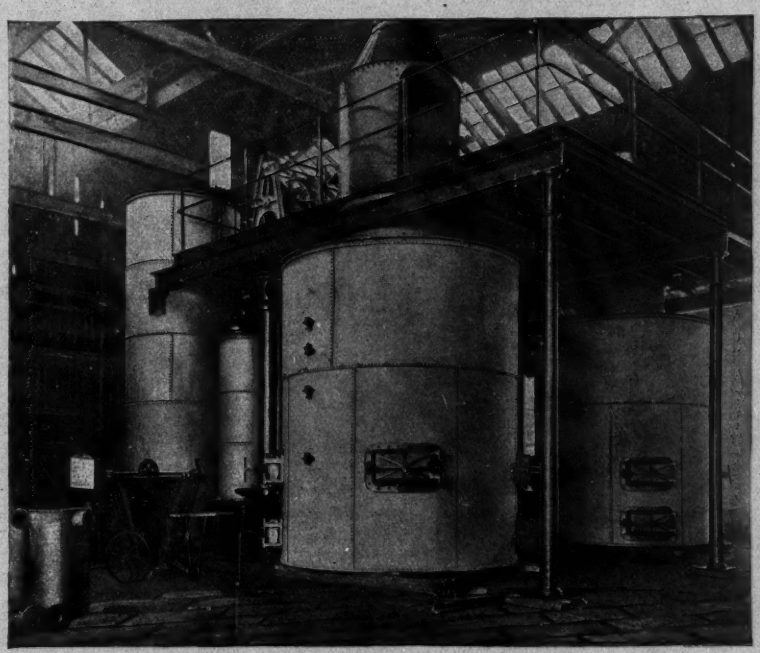
SHOULD CONSULT

R. & J. DEMPSTER, LTD.,

MANCHESTER,

Sole Agents in Great Britain for the

"DELLWIK-FLEISCHER WATER-GAS PLANT."



DELLWIK-FLEISCHER WATER-GAS PLANT.

In course of construction at the works of Messrs. R. & J. Dempster, Limited, Manchester.

THIS PLANT HAS BEEN TRIED AND PROVED TO BE ONE OF THE MOST REMARKABLE INVENTIONS OF THE AGE.

Best results obtained when using either

OIL or BENZOL ENRICHMENT.

(*SEE REPORTS ON OTHER SIDE*).

[P.T.O.

Extracts from letters received from various Engineers where the plant has been adopted:—

With 90 per cent. Benzol at 10d. per gallon, the total cost of Purified and enriched gas would be about 9d. per 1000 cubic feet into the holder, and I look upon the system as a valuable one.

(Extract from Mr. GLOVER'S Report of the West Bromwich Plant.)

We are thoroughly satisfied with the results we have obtained from the adoption of the Dellwik Plant, and I have no doubt as to the correctness of Professor Lewes' theory: There have also been no complaints recently of Naphthalene, and we are now free from stopped pipes, good effects which I attribute to the Lewes process.

(Extract from letter sent by Mr. STEPHENSON, Engineer, Tipton Gas-Works.)

Altogether I am very pleased with the whole plant, the working is most simple, and I am confident that we shall be able to reduce the cost of the whole of our Gas 4d. to 5d. per 1000 cubic feet in the Holders.

(Extract from letter received from Mr. BROCKWAY, Engineer, Cleethorpes Gas Company.)

Within the last Two Years this Plant has been adopted at a large number of industrial establishments, and also at the following Gas-Works:

WEST BROMWICH, ILFORD, TIPTON, CLEETHORPES, BILSTON, CAPE TOWN, RUSHDEN and HIGHAM FERRERS.

Full Information and Prices supplied on application to

R. & J. DEMPSTER, LTD.,

OLDHAM ROAD, MANCHESTER.

LONDON OFFICES - - - - 165, GRESHAM HOUSE, E.C.

Printed for WALTER KING by King, Sell, & Olding, Ltd.; and published by him at 11, Bolt Court, Fleet Street, in the City of London.—Tuesday, June 16, 1908.

OXIDE OF IRON.

O'NEILL'S OXIDE has a larger annual sale than all other Oxides combined.

SPENT OXIDE purchased in any district.

GAS PURIFICATION & CHEMICAL CO., LD.,

JOHN WM. O'NEILL, Managing Director,

PALMERSTON HOUSE, LONDON, E.C.

WINKELMANN'S

"VOLCANIC" FIRE CEMENT.

Resists 4500° Fahr. Best for GAS-WORKS.

ANDREW STEPHENSON, 182, Palmerston House, Old Broad Street, London, E.C. "Volcanism, London."

BROTHERTON & CO., LIMITED.

Offices: Commercial Buildings, LEEDS. Correspondence invited.

DON'T fail to see Edgar's Induced CURRENT SELF-INTENSIFYING GAS-LANTERN. Candle Power over 1000 at small gas consumption. Does not require any high-pressure mains or costly compressing plant. Used for lighting the showrooms of the Gaslight and Coke Company.

WILLIAM EDGAR, Blenheim Engineering Works, Hammersmith, W. (entrance in Waterloo Street), where full Particulars and all Information of up-to-date Gas Appliances will gladly be furnished.

Telegrams: "Gasoso, London". Telephone: 14 Hammersmith.

SULPHATE OF AMMONIA SATURATORS and LEAD WORK for Sulphate of Ammonia Plants.

For REPAIRS or ALTERATIONS, ring up "0848 BOLTON," or Telegraph "SATURATORS, BOLTON."

Largest Practice and most Up-to-Date Works in Britain.

JOSEPH TAYLOR AND CO., CENTRAL PLUMBING WORKS, BOLTON.

GAS TAR wanted.

BROTHERTON AND CO., LTD., Tar Distillers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

IT is worth your while to buy direct. THE RELIANCE LUBRICATING OIL COMPANY 19 and 20, Water Lane, Great Tower Street, London, E.C., handle all kinds of Lubricating Oils, for Engines, Cylinders, Dynamos, Spindles, &c., Burning Oils, Solar Distillates, Carburetting Oils, and Spirits for Gas Making; Motor Oils, Fuel Oils, Animal, Fish, and Vegetable Oils, &c., for all purposes. Write for our "Trade Mark" Inkstand, sent free to customers. Non-customers, 2s. 6d. each. RELIANCE LUBRICATING OIL COMPANY, London, Glasgow, Newcastle-on-Tyne, &c. Established 1858. Telegraphic Address: "Subastral," London; A.B.C. Code used. Telephone No.: Avenue 5891.

JOHN RILEY & SONS, Chemical Manufacturers, Hapton, near Accrington, are MAKERS of Special SULPHURIC ACID, for Sulphate of Ammonia Making. Highest percentage of Sulphate of Ammonia obtained from the use of this Vitriol, which has now been used for upwards of 50 Years. References given to Gas Companies.

SULPHURIC ACID for Sale.

BROTHERTON AND CO., LTD., Chemical Manufacturers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

PENNY-IN-THE-SLOT WORK.

H. GREENE & SONS, Ltd., are prepared to give QUOTATIONS to Gas Companies or Corporations for FITTING UP COMPLETE and CARRYING OUT the WORK in its entirety, either in Iron or Compo.

SURREY ENGINEERING WORKS, BLACKFRIARS ROAD, LONDON, S.E.

Telephone: 1693 HOP. Telegrams: "LUMINOSITY."

PATENTS AND TRADE MARKS PUBLICATIONS. "MERCHANDISE MARKS ACT, and Decisions thereunder," 1s.; "TRADE SECRETS v. PATENTS," 6d.; "DOCTRINE of EQUIVALENTS, Mechanical and Chemical," 6d.; "SUBJECT-MATTER of PATENTS," 6d.

MEWBURN, ELLIS, & PRYOR, Chartered Patent Agents, 70 and 72, Chancery Lane, London, W.C. Telegrams: "Patent London." Telephone: No. 243 Holborn.

HYDRATED OXIDE OF IRON.

PREPARED from Pure Iron.

Twice as Rich as Bog Ore.
Gives no Back Pressure.
The Cheapest in the Market.
Can be Lent on Hire.
Can be Exchanged for Spent Oxide.

READ HOLLIDAY AND SONS, LTD., HUDDERSFIELD.

AMMONIACAL LIQUOR wanted.

BROTHERTON AND CO., LTD., Ammonia Distillers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

STREET AND SHOP LAMPS AND LANTERNS.

MARK DUFFIELD & SONS (Established 200 Years), Makers of Street and Shop Lamps to own Pattern and Design. Any description of Lamp made. Inquiries invited.

London Manager: EDWARD PADFIELD, West India House, 96 & 98, LEADENHALL STREET, E.C.

Telegraphic Address: "EUPATHY, LONDON,"

J. & J. BRADDOCK (Branch of Meters Limited), Globe Meter Works, OLDHAM, and 45 & 47, Westminster Bridge Road, LONDON, S.E.

First-Class Award, Melbourne Exhibition, 1889, for WET AND DRY GAS-METERS, STATION METERS, AND GOVERNORS, PRESSURE-GAUGES, STREET LAMPS AND PILLARS, &c.

Telegraphic Addresses:
"Braddock, Oldham." "Metrique, London."

DUTCH OXIDE OF IRON.

THE First Dutch Bog Ore Co., Ltd. (Eerste Hollandsche Yzererts Maaty), ROTTERDAM.

General Manager for England and Wales)—
CHARLES E. FRY, LEAMINGTON; and at Tower Chambers, Brown Street, MANCHESTER.

London Managers—
E. PADFIELD & CO., 96-98, Leadenhall Street, LONDON, E.C.

General Manager (for Scotland)—
J. B. MACDERMOTT, 11, Bothwell St., GLASGOW.

SPECIAL PAINT FOR GAS-WORKS.

JOHN E. WILLIAMS AND CO.,
VICTORIA PAINT WORKS,
MANCHESTER.

Telegrams: "ENAMEL." National Telephone 1759.

GAS-METERS wanted, old disused Wet. Copper Lamp Frames, Brass, Pewter, Tin, Zinc, Lead Ashes, Old Copper Electric Cable, &c., for Cash.

J. SMITH, Canal Road, BRADFORD.

TO GAS AND WATER OFFICIALS.

COURT ROYAL CYCLES are largely supplied to Public Officials. Specially REDUCED PRICES to GAS MANAGERS and ASSISTANTS where unrepresented. See and test one of these sterling high-grade Manufactures before deciding upon any new purchase. Large Catalogue, Books of Testimonials, and Special Prices sent, on application, from the Makers LLOYD COURTS AND CO., COVENTRY.

AMMONIACAL Liquor wanted by JOHN RILEY & SONS, Hapton, near ACCRINGTON.

AUTOMATIC INSTALLATIONS.

OBTAIN quotations for above from WILLIAM EDGAR, who has special facilities, and whose experience in this department is unique. Compo. or Iron. Contractor to the Gaslight and Coke Company, The South Metropolitan Gas Company, The West Ham Gas Company, and the Brentford Gas Company.

WILLIAM EDGAR, Blenheim Engineering Works, Hammersmith, W. (entrance in Waterloo Street).

Telegrams: "Gasoso, London." Telephone: 14 Hammersmith.

TRAVELLER is shortly Open to an ENGAGEMENT with a firm of Gas Engineers and Contractors. Extensive connection and can introduce good business.

Address No. 4032, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a position in or near London as DRAUGHTSMAN or REPRESENTATIVE Twelve Years' practical Experience with leading Gas Engineers. Well up in all branches of the Gas Industry.

Address No. 4046, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

GENTLEMAN, with large Experience in Gas Engineering and good Connection in the South of England, is prepared to call on Gas-Works and take Particulars, Dimensions, &c., for Provincial Firms of Contractors tendering for work. Best credentials.

Address No. 4045, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

A GENTLEMAN (Age 30), with Twelve Years' experience in a leading Gaslight Company—Correspondence (Shorthand), Rentals, Stock-Ledgers, Transfers, Shares, Board Records, Dividends, &c., &c.—desires an APPOINTMENT in or about London. Highest Testimonials. Personal References. Salary £100 per annum. One Month's Approbation.

Address No. 4033, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a Rental and General Clerk, quick at figures and Accurate. Also Slot-Meter INSPECTOR and COLLECTOR.

No Amateurs need apply.

Apply to G. STEVENSON, Gas-Works, LONG EATON.

WANTED, a capable Man as LampLIGHTER and CLEANER, with a knowledge of Incandescent Burners.

Only Men of good and reliable Character need apply to the MANAGER, Gas-Works, Wells, SOMERSET.

GENERAL Foreman required for large Provincial Gas-Works. Applicants not to exceed 40 Years of age. Must be steady and reliable, strict disciplinarian, accustomed to control of Men, good Carbonizer, familiar with Carburetted Water-Gas Plant, and preferably to have had Mechanical Training.

Wages £3 per week. No House, Coal, or Gas.

Applications, stating Age and Experience, accompanied by *copies* of not more than Three recent Testimonials, to be addressed to No. 4047, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C., not later than Wednesday, June 24, 1903.

COAL GAS TAR wanted.

Gas Managers in Gloucester, Somerset, Worcester, Devon, Wilts, Hereford, Monmouth, and Glamorgan PLEASE NOTE. BEST PRICE offered, either on Fixed or Sliding-Scale Basis.

State Quantity to offer for Prompt and Forward Delivery.

The SHARPNESS CHEMICAL COMPANY, Tar Distillers, Sharpness Docks, GLOS.

OXIDE OF IRON.

(NATURAL.

BALE & CHURCH will be pleased to send Samples and Quotations, and make Offers for SPENT OXIDE.

BALE'S FIRE CEMENT, PAINT, AND GAS COAL,

5, CROOKED LANE, LONDON, E.C.

ATHERSTONE GASLIGHT AND COKE COMPANY.

WANTED, on the 1st of September next, a WORKING MANAGER for the Atherstone Gas-Works (Yearly Make about 22,500,000 cubic feet).

Salary at the rate of £120 per annum, with House, Coal, and Gas free.

Applications, stating Age and Qualifications, with three original recent Testimonials, to be sent to me before Monday, the 22nd inst.

W. A. HALTON,
Secretary.

Atherstone, June 3, 1903.

WANTED, Gas Carbon, in Four Ton Lots or more, f.o.r. Must be Clean and Hard Lumps.

Address No. 4044, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

TO BE SOLD—Purifiers, Two or Four, 10 feet square by 4 ft. 6 in. deep, planed Joints, Connections, and Overhead Girders.

Write J. WRIGHT, 181, QUEEN VICTORIA STREET, E.C.

FOR SALE—Four 12 feet square Purifiers, with 12-inch Connections, Centre-Valve, and Grids Complete, put on rail for £200.

For further Particulars, apply to C. F. RUGGLES, Gas-Works, LEIGHTON BUZZARD.

FOR SALE—Messrs. Glover and Mains, Limited, 15 £10 Ordinary Shares, 10 £10 5 per per cent. Preference Shares, £100 Mortgage Debenture Stock—Interest 4½ per cent. per annum.

Address No. 4049, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

CANNOCK, HEDNESFORD, AND DISTRICT GAS COMPANY, LIMITED.

FOR SALE—One cylindrical Station METER, to pass 5000 cubic feet per hour. May be seen working at the Gas-Works, Cannock.

Further Particulars from, and offers to,

T. A. NICHOLLS,
Secretary.

GAS PLANT for Sale—I can always offer NEW and SECOND-HAND GAS APPARATUS including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also a few COMPLETE WORKS. Compare Prices and Particulars before ordering elsewhere.

J. F. BLAKELEY, Gas Engineer, Thornhill, DEWSBURY.

GAS PLANT FOR SALE.

OWING to the acquirement of the Works of the Colne Vale Gas Company, and the closing down of these Works, the Longwood Gas Company have FOR SALE the following PLANT in good condition:—

One HOLMES' TOWER SCRUBBER, 5 ft. by 12 ft., mounted on Thurston's Square Tar-Extractor, 5 ft. 6 in. by 5 ft.
One HOLMES' WASHER, cylindrical, 16 ft. by 4 ft. 6 in., with Rope Driving Gear and Shaft.
One COWAN CYLINDRICAL STATION METER, measuring 6 ft. 6 in. by 6 ft., with 12-inch Connections; capacity 10,000 feet per hour.
One 5000 cubic feet per hour EXHAUSTER, with Accessories and Engine in duplicate.
One 500-light STATION METER.
One Wrought-Iron Cylindrical STORAGE TANK, 26 ft. by 7 ft.
One Cast-Iron STORAGE TANK, 6 ft. 6 in. by 5 ft. by 5 ft., with Cast-Iron Draw-Off Cock.
Six Cast-Iron CONDENSERS, each 9 ft. 6 in. high, and 2 ft. diameter, with square base, 17 ft. by 3 ft by 1 ft. 3 in., fitted with Cleaning-Out Lids for each Pipe.
The following MOUTHPIECES, with Ascension and Dip Pipes to suit:—
28 OVALS, 18 in. by 14 in.
Seven OVALS, 18 in. by 15 in.
27 □ 21 in. by 15 in.
Two Cast-Iron SLAKING TROUGHS, 4 ft. by 2 ft. 6 in. by 2 ft.
Also 100 Second-hand STREET LANTERNS.

Inspection invited.

Further Particulars on application to

J. H. BREARLEY,
Gas Engineer.

Longwood.

FOR SALE—Four Purifiers, 6 feet square, by 2 ft. 10 in., complete with 6-inch Connections, Dry Centre-Valve, Bearing-Bars, Wood Grids, and Lifting Screws for Covers. All in excellent condition, and ready for removal.

Also one 8-inch STATION GOVERNOR.

Apply, MASTER, Walton Workhouse, LIVERPOOL.

METROPOLITAN BOROUGH OF ISLINGTON.

THE Council are prepared to receive TENDERS for the purchase of about 3900 LANTERNS, SPRAY IRONS, CRADLES, and BRASS TAPS, which are about to be removed from the Lamp-Columns in the Streets within the borough.

Forms of Tender and all Particulars can be obtained on application to the Borough Engineer.

Tenders, endorsed "Purchase of Gas-Lanterns, &c.," must be received by the undersigned not later than Three p.m. on Wednesday, the 24th of June, 1903.

WM. F. DEWEY,
Town Clerk.

Town Hall, Upper Street,
Islington, N., June 13, 1903.

CITY OF CARLISLE.

THE Carlisle Gas Committee are prepared to receive TENDERS for the purchase of the Surplus TAR to be produced at their Works during the Nine Months ending March 25, 1904.

Tenders, endorsed "Tar," and addressed to the Chairman of the Gas Committee, to be delivered at the Office of the Town Clerk, not later than June 30, 1903.

Further Particulars can be obtained on application.

By order,
W. J. SMITH,
Engineer and General Manager.

Gas-Works, Carlisle,
June 10, 1903.

CITY OF CARLISLE.

THE Carlisle Gas Committee are prepared to receive TENDERS for the COAL and CANNEL required at their Works during One Year from the 1st of July next.

Tenders, endorsed "Coal," and addressed to the Chairman of the Gas Committee, to be delivered at the Office of the Town Clerk, not later than June 30, 1903.

Forms of Tender and other Particulars may be had on application to the undersigned.

By order,
W. J. SMITH,
Engineer and General Manager.

Gas-Works, Carlisle,
June 10, 1903.

ST. ANNES-ON-THE-SEA GAS COMPANY.

TENDERS are invited for the supply of 5000 Tons of Best Screened GAS COAL, to be delivered as required during the ensuing Twelve Months, commencing July 1, 1903.

Tenders, endorsed "Coal," and giving full Particulars of the Coal offered, to be sent in not later than Thursday morning, June 25, 1903.

No special Form of Tender issued.

The Directors reserve to themselves the right to divide the quantity into two Contracts.

WILLIAM H. NUTTER,
Secretary and Manager.

Gas Offices,
St. Annes-on-the Sea,
June 11, 1903.

CITY OF BRADFORD.

TO COLLIERY PROPRIETORS AND OTHERS.

THE Gas Committee of the Bradford Corporation are prepared to receive TENDERS for the supply of Best GAS COAL COBBLES, NUTS, and CANNEL, all to be well screened, dressed, and free from Shale and Pyrites, to be delivered at the several Works of the Corporation during the period of One Year commencing on the 1st day of August next.

Form of Tender, with any further Information required, may be had on application to Mr. Wood, Gas Engineer, Town Hall.

Sealed Tenders, endorsed "Tender for Coal," to be sent to me on or before Wednesday, the 1st of July next.

Persons tendering must give an assurance that they have paid to their Workmen for the three months preceding date of Tender not less than the minimum standard rate of wages, and undertake to continue to pay during the contract the said rate of wages.

The lowest or any Tender will not necessarily be accepted.

FREDERICK STEVENS,
Town Clerk.

Town Hall, Bradford,
June 6, 1903.

BOROUGH OF CONGLETON.

THE Gas Committee invite Tenders for the following:—

1.—GAS COAL.

The supply of Best Screened GAS COAL or NUTS for Gas-Making purposes, to be delivered in Senders' or Railway Company's Trucks at Brunswick Wharf, Congleton (N. S. R.), during the Twelve Months ending June 30, 1904.

Forms of Tender and Conditions may be obtained from the undersigned.

2.—LIME.

The supply of about 150 Tons of Best Hand-Picked LIME for Purifying Purposes, to be delivered in Senders' or Railway Company's Trucks at Brunswick Wharf, Congleton (N. S. R.), in such quantities and at such times as may be required during the Twelve Months ending June 30, 1904.

No Special Form required.

Tenders, endorsed "Coal" or "Lime" respectively, to be delivered at the Office of E. A. Plant, Esq., Town Clerk, Congleton, on or before Saturday, the 20th day of June, 1903.

The Committee do not bind themselves to accept the lowest or any Tender.

J. SMITH,
Engineer and Manager.

Gas-Works, Congleton,
June 3, 1903.

CARDIFF GASLIGHT AND COKE COMPANY.

TENDERS FOR COALS.

THE Directors of the above Company are prepared to receive TENDERS for a supply of 80,000 Tons of Best Well-Screened Large GAS COALS, to be delivered between the 1st of July, 1903, and the 30th of June, 1904, in monthly quantities in accordance with the Specification.

Parties tendering may do so for the whole quantity, or for quantities from 5000 tons upwards.

Forms of Tender and Specification of monthly deliveries may be obtained on application to the Engineer and Manager, Mr. H. Morley, M.Inst. C.E.

Sealed Tenders to be sent to the undersigned not later than Ten a.m. on Thursday, the 25th day of June next, addressed to the Chairman of the Company, endorsed "Tender for Coal."

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right to apportion the whole quantity as they may think fit.

By order,
GEORGE CLARRY,
Secretary.

Gas Offices, Cardiff,
May 16, 1903.

CARDIFF GASLIGHT AND COKE COMPANY.

TENDERS FOR CAST-IRON PIPES.

THE Directors of the above Company are prepared to receive TENDERS for a supply of Cast-Iron Spigot and Socket PIPES, also IRREGULAR PIPES, for delivery from the 1st of July, 1903, to the 30th of June, 1904, in such quantities as may be required.

Forms of Tender and Specifications may be obtained on application to the Engineer and Manager, Mr. Hy. Morley, C.E.

Sealed Tenders to be sent to the undersigned not later than Ten a.m. on Thursday, June 25 next, addressed to the Chairman of the Company, and endorsed "Tender for Pipes."

The Directors do not bind themselves to accept the lowest or any Tender.

By order,
GEORGE CLARRY,
Secretary.

Gas Offices, Cardiff, June 3, 1903.

URBAN DISTRICT COUNCIL, BOROUGH OF NEWRY.

TENDERS FOR GAS COAL.

THE Gas Committee of the above Council invite TENDERS for the supply of from 3500 to 4000 Tons of best screened GAS COAL (with quotation for unscreened Gas Coal at same time) for a period of Twelve Months, to be delivered in such quantities and at such times as may be required by the Committee, and to weigh 20 cwt. to the Ton over the Gas Committee's Weighbridge at their Works (said Machine is regularly inspected by Officer under Weights and Measures Act), and delivered *free ex* Ship or Steamer at Albert Basin, Newry.

The Coal to be Fresh Wrought, Dry, and Free from Hards, Smudge, Dirt, Shale, Pyrites, or other Objectionable Matter for Gas Making.

Further Particulars may be obtained from Mr B. Gibson, Manager.

Sealed Tenders, endorsed "Tender for Coal" specifying the description and quality of the Coal, and where raised, to be addressed to T. P. Ledlie, Esq., Chairman, and delivered to the undersigned not later than 10.30 a.m., on Friday, the 19th of June.

The Committee reserve to themselves the right to accept the whole or any portion of any quantity offered, and do not bind themselves to accept the lowest or any Tender. They also reserve the power to decline acceptance of any Coal not equal in their belief to that contracted for.

ROBERT H. DOHERTY,
Clerk,
Urban District Council of Newry,
New Town Hall, Newry,
May 29, 1903.

SUTTON-IN-ASHFIELD URBAN DISTRICT COUNCIL.

(GAS DEPARTMENT.)

TENDERS FOR GAS COAL, CANNEL, AND LIME.
TENDERS FOR COKE, TAR, AND AMMONIACAL LIQUOR.

COAL.

THE Gas Committee of the above Council are prepared to receive TENDERS for the supply of 1000 Tons of CANNEL, and 4500 Tons of well-screend GAS COAL, to be free from Shale and Pyrites, and to be delivered at the Town Stations (Midland or Great Northern Railways), Sutton-in-Ashfield, in such quantities as the Manager shall from time to time direct between July 1, 1903, and June 30, 1904.

LIME.

Also for the supply of about 250 Tons of LIME, to be delivered at either of the above Railway Stations, in such quantities as the Manager shall from time to time direct between July 1, 1903, and June 30, 1904.

The Lime is to be hand picked, and clear from Refuse and Ashes.

COKE, TAR, AND LIQUOR.

Tenders are invited for the COKE and surplus TAR and AMMONIACAL LIQUOR produced at their Works from July 1, 1903, to June 30, 1904, to be delivered in Purchasers Tank-Waggons at the Midland or Great Northern Railway Stations, Sutton-in-Ashfield.

Tenders for Coal to state price per ton of 20 cwt., at the Works or above Railway Stations.

No Tender Forms provided.

The Committee do not bind themselves to accept the lowest or any Tender.

Tenders, endorsed, to be addressed as under, so as to arrive not later than the 22nd of June, 1903.

By order,
JOHN D. FIDLER,
Clerk.

Council Offices, Sutton-in-Ashfield,
June 12, 1903.

THE Directors of the Keswick Gas Company invite TENDERS for their Surplus TAR and AMMONIACAL LIQUOR for Twelve Months from the 30th inst., at per ton, delivered into Contractors' Tanks at Keswick Railway Station.

Sealed Tenders, endorsed "Tender for Tar" or "Liquor," will be received by the undersigned on or before Wednesday, the 24th inst.; but the Directors do not bind themselves to accept the highest or any Tender.

J. H. BRODIE,
Secretary.

Main Street, Keswick,
Cumberland, June 10, 1903.

LEEK URBAN DISTRICT COUNCIL.

TO COLLIERY PROPRIETORS AND OTHERS.

TENDERS are invited for the Supply of all or any portion of Best Washed NUTS and BEANS required at the Leek Gas-Works during the year ending the 30th of June, 1904, delivered at the North Staffordshire Railway Station.

Annual consumption, 8000 to 9000 Tons.

Forms of Tender and Further Particulars may be obtained from the undersigned.

Endorsed Tenders, addressed to the Chairman of the Gas Committee, to be delivered at the Town Hall, Leek, on or before Saturday, June 27 inst.

The lowest or any Tenders will not necessarily be accepted.

By order,
C. HENSHAW,
Clerk.

Town Hall, Leek,
June 10, 1903.

LEEK URBAN DISTRICT COUNCIL.

TO TAR DISTILLERS AND OTHERS.

TENDERS are invited for the Purchase of the SURPLUS GAS TAR and AMMONIACAL LIQUOR produced at the Leek Gas-Works for One, Two, or Three Years from the 1st of July, 1903, at per ton of 2240 lbs. at such works.

Endorsed Tenders, addressed to the Chairman of the Gas Committee, to be delivered at the Town Hall, Leek, on or before Saturday, the 27th of June inst.

Forms of Tender and further Particulars may be obtained from the undersigned.

The highest or any Tender will not necessarily be accepted.

By order,
C. HENSHAW,
Clerk.

Town Hall, Leek,
June 10, 1903.

GORING AND STREATLEY DISTRICT GAS AND WATER COMPANY, LIMITED.

WATER-SUPPLY EXTENSIONS.

CONTRACT NO. 1.

HIGH-PRESSURE RISING MAIN AND TELEPHONE CABLE.

THE Directors are prepared to receive TENDERS for the supplying, hauling, and laying of about 5000 Yards of HIGH-PRESSURE RISING MAIN from their existing Reservoir, Goring-on-Thames, to the new Reservoir Site, Greenmore Hill, Woodcote, Oxfordshire, in accordance with Plans and Specification prepared by their Engineer, Mr. George H. Robus, Mansion House Chambers, London, E.C., where Plans may be seen, and copy of Specification obtained, on payment of £3 3s., which will be returned on receipt of a *bonâ-fide* Tender.

The Directors reserve the right to accept the lowest or any Tender.

Sealed Tenders, endorsed "Water-Works Extensions," and addressed to the Chairman, Goring and Streatley District Gas and Water Company, Limited, 20, Bucklersbury, London, E.C., should reach me not later than June 26, 1903.

The Engineer will attend at the Water-Works, Goring-on-Thames, on Friday, June 19, 1903, at Two o'clock, for the purpose of going over the proposed Line of Main with intending Contractors or their Representatives.

J. HUNT,
Secretary.

London, June 2, 1903.

URBAN DISTRICT COUNCIL OF COLWYN BAY AND COLWYN.

(GAS DEPARTMENT.)

THE above Council invite Tenders for the supply of from 4000 to 4200 Tons of best screened GAS COAL, to be supplied during the ensuing Twelve Months ending June 30, 1904.

Tenders, stating price per ton, delivered as required free at Colwyn Bay Station, endorsed "Tender for Coal," to be sent in addressed to the undersigned on or before Wednesday, the 24th inst.

The Council do not bind themselves to accept the lowest or any Tender, and reserve the right to purchase any portion of the quantity offered.

TENDERS are also invited for the following EXTENSIONS AT THE GAS-WORKS.

Namely, Three beds of Eight RETORTS on the Regenerator System, with Waddell's or Brearley's Regenerator Flues, and all Furnace Fittings, Retort Mountings, and Subway Floor.

Plans may be seen, and a copy of Specification and Form of Tender obtained, on application to Mr. Jno. C. Pennington, Gas Engineer and Manager, Colwyn Bay.

Sealed Tenders, endorsed "Gas-Works Extens ons," to be sent in addressed to the undersigned on or before Wednesday, the 24th inst.

The Council do not bind themselves to accept the lowest or any Tender.

(Signed) JOS. H. ROBERTS.
Clerk.

Council Offices, Colwyn Bay,
June 6, 1903.

GAS TAR.

THE Urban District Council of Atherton invite TENDERS for the purchase of the TAR produced at their Gas-Works during Twelve Months from the 30th of June inst.

Probable quantity about 450 Tons.

Sealed Tenders to be delivered to the undersigned on or before Wednesday, the 17th inst.

D. SCHOFIELD,
Clerk.

CORPORATION OF BLACKPOOL.

(GAS DEPARTMENT.)

THE Gas Committee are prepared to receive TENDERS for the supply of COAL for the ensuing Year from the 1st of July.

Forms of Tender may be had from the undersigned, and must be sent in by the 25th of June, endorsed outside, and addressed to the Chairman of the Gas Committee.

By order,
JOHN CHEW,
Gas Engineer.

Gas Office, Princess Street,
June 10, 1903.

BRITISH GASLIGHT COMPANY, LIMITED.

NORWICH WORKS.

TENDERS are invited for the Erection of RETORT-HOUSE, COAL-STORES, and other BUILDINGS.

Bill of Quantities, Specifications, and Drawings may be seen at my Office, Bishop Bridge, Norwich, on or after the 8th of June.

Tenders to be deposited at the London Office of the Company, 11, George Yard, Lombard Street, addressed H. Burton Chamberlain, Esq., Secretary, not later than the 22nd of June, 1903, and endorsed "Tender for Buildings."

The Company do not pledge themselves to accept the lowest or any Tender.

THOMAS GLOVER,
Engineer and Manager.

Norwich, May, 1903.

LINCOLN CORPORATION.

(GAS DEPARTMENT.)

TENDERS FOR COAL.

THE Gas Committee of the Lincoln Corporation invite TENDERS for the supply of 26,000 Tons of unscreened or screened GAS COALS and NUTS, to be delivered during a period commencing the 1st of July, 1903, and terminating the 30th of June, 1904.

Further Particulars and Forms of Tender may be obtained from the undersigned.

Sealed and endorsed Tenders, addressed to the Chairman of the Gas Committee, must be delivered on or before the 20th of June next.

The Committee do not bind themselves to accept the lowest or any Tender.

JNO. CARTER,
Manager.

Gas Offices, Lincoln,
June 4, 1903.

GAINSBOROUGH URBAN DISTRICT COUNCIL.

(GAS DEPARTMENT.)

TENDERS FOR GAS COAL.

THE Gas Committee of the above Council invite TENDERS for the supply of 6000 Tons of best GAS COAL (screened, unscreened, or nuts), to be delivered at the G. C. Railway Station, Gainsborough, between the 1st of July, 1903, and the 30th of June, 1904, in such quantities, monthly, as may be required.

Sealed Tenders, endorsed "Tender for Gas Coal," giving full Particulars of the Coal offered, to be addressed to the Chairman of the Gas Committee, must be delivered at the Gas-Works, Gainsborough, not later than the 23rd inst.

No special Form of Tender issued.

The Committee do not bind themselves to accept the lowest or any Tender.

JOHN BALDWIN,
Manager.

Gas-Works, Gainsborough,
June 6, 1903.

CITY OF NOTTINGHAM.

(WATER DEPARTMENT.)

TENDERS for the Supply of Valves and HYDRANTS, PIPES, LEAD, COAL, TAPS, and FITTINGS.

The Water Committee of the Corporation are prepared to receive TENDERS from competent Ironfounders, Brassfounders, Valve Manufacturers, Lead Merchants, and Colliery Proprietors and Coal Merchants for the Supply of the undermentioned Goods for the ensuing year:—

1.—CAST-IRON DOUBLE-FACED SLUICE VALVES and HYDRANTS.
2.—CAST-IRON MAIN PIPES.
CAST-IRON SPECIAL PIPES.
3.—LEAD PIPING.
LEAD INGOTS.
4.—GUN METAL TAPS & FERRULE FITTINGS.
5.—STEAM COAL and OTHER FUEL.

Specifications and Drawings, together with Samples, Weights, &c., may be seen, and other Information Obtained, at the Office of the Water Manager, Mr. Stephen Moore, St. Peter's Church-side, and Forms of Tender may be obtained at that Office on payment of One Guinea, which sum will be returned on receipt of a *bonâ-fide* Tender.

Tenders, endorsed "Tender for Valves," "Tender for Pipes," "Tender for Lead," "Tender for Taps," or "Tender for Coal," to de delivered to me at the Guildhall, Nottingham, on or before the 26th day of June inst.

The Committee do not bind themselves to accept the lowest or any Tender.

By order of the Water Committee,
SAMUEL G. JOHNSON,
Town Clerk.

Guildhall, Nottingham,
June 11, 1903.

RADCLIFFE AND PILKINGTON GAS COMPANY.

TENDERS FOR COAL.

THE Directors invite Tenders for a Twelve Months' supply of GAS COAL.

Particulars may be obtained from the undersigned, by whom Tenders will be received until Wednesday, the 24th inst.

JAMES BRADDOCK,
Manager and Secretary.

Gas Offices, Radcliffe,
June 6, 1903.

BARNSTAPLE GAS COMPANY.

TENDERS FOR COAL.

THE Directors invite Tenders for the supply of about 4000 Tons of Best-Screened GAS COAL, to be delivered at Fremington Quay or Barnstaple Station, between the 1st of July next and the 30th of June, 1904.

Tenders to be sent to the undersigned not later than Saturday, the 27th inst.

The lowest or any Tender not necessarily accepted.

F. L. SCHOFIELD,
Manager and Secretary.

Gas Offices, Barnstaple,
June 11, 1903.

HOLYHEAD AND NORTH WALES GAS AND WATER CORPORATION, LIMITED.

TENDERS FOR COAL.

THE Directors of the above Company are prepared to receive TENDERS for the supply and delivery of COALS to their various Works for the ensuing Year.

Full Particulars and Forms of Tenders may be had on application to the undersigned, to whom sealed Tenders, endorsed "Tender for Coal," must be sent not later than Twelve noon, on Thursday, June 25, 1903.

GEORGE E. SAVILLE,
Managing-Director.

Penmeanmawr,
June 5, 1903.

URBAN DISTRICT COUNCIL OF ELLESMERE.

CONTRACT FOR GAS COAL.

THE above Council are prepared to receive TENDERS for the supply of COAL for their Gas-Works during the Year ending the 24th of June, 1904.

The Coal must be a good Gas Coal, screened, and delivered free at Ellesmere Railway or Canal Wharves.

Sealed Tenders, endorsed "Tenders for Gas Coal," accompanied by analyses, to be sent to me not later than Thursday, July 2, 1903.

R. E. LLOYD,
Clerk to the Council.

Ellesmere,
June 11, 1903.

BOROUGH OF DARWEN.

THE Gas Committee of the above Corporation are prepared to receive TENDERS for the supply of the following Goods for One Year:—

(1)—BENZOL.
(2)—WROUGHT-IRON TUBES and FITTINGS.
(3)—FIRE-CLAY, RETORTS, BRICKS, &c.

Further Particulars and Form of Tender may be obtained on application to Mr. A. H. Smith, Gas Engineer, Darwen.

Sealed and endorsed Tenders must be delivered to the undersigned not later than Saturday, the 27th day of June.

The Committee do not bind themselves to accept the lowest or any Tender.

By order,
WILLIAM P. HALLIWELL,
Town Clerk.

Town Clerk's Office,
June 8, 1903.

TENDERS FOR COAL.

THE Directors of the Town of Dudley Gaslight Company are prepared to receive TENDERS for the supply of about 15,000 Tons of GAS COAL or NUTS, to be delivered at the London and North-Western Railway or Great-Western Railway Sidings, Dudley, or Great-Western Railway Siding, Netherton, in such quantities as may be required from the 1st of July next to the 30th of June, 1904.

Sealed Tenders, addressed to the Chairman, and endorsed "Tender for Coal," to be sent in not later than the 22nd inst.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right to divide the Contract between two or more firms.

By order,
T. E. STILLARD,
Secretary.

Gas-Works, Dudley,
June 10, 1903.

COUNTY BOROUGH OF HALIFAX.

THE Gas-Works Committee of the Halifax Corporation invite TENDERS for the supply of: (1) BRASS LAMP FITTINGS. (2) BRASS MAIN COCKS and UNIONS. (3) OXIDE OF IRON. (4) SULPHURIC ACID. (5) LIME.

And for the Purchase of: (1) BRIMSTONE. (2) GAS CARBON. (3) Spent OXIDE OF IRON, during the Twelve Months ending the 30th of June, 1904.

Forms of Tender and further Information may be obtained on application to the Manager, Gas-Works, Halifax.

Tenders, properly endorsed, to be sent to the undersigned not later than Ten o'clock a.m. on Wednesday, the 24th of June, 1903.

The persons whose Tenders are accepted will be required to observe the Fair Contracts Clauses adopted by the Corporation.

By order,
KEIGHLEY WALTON,
Town Clerk.

TAR Contracts Wanted on the Sliding Scale or at Fixed Prices.

Managers and Secretaries desirous of selling to best advantage please communicate with DENT AND CO., Ouse Chemical Works, SELBY.

CORPORATION OF DUKINFIELD.

(GAS DEPARTMENT.)

TENDERS FOR GAS COAL.

THE Gas Committee require Tenders by the 24th of June, 1903, for 5000 Tons of best screened GAS COAL.

Specification and Forms of Tender on application to Mr. Harrison Veevers, Town Hall, Dukinfield.

Tenders to Mr. Councillor COOKE, Chairman of the Gas Committee, Town Hall, DUKINFIELD.

RUTHIN GAS COMPANY.

TENDERS are invited for the supply of from 600 to 700 Tons of good screened GAS COAL, to be delivered at Ruthin Station, in such Monthly Quantities as may be required for Twelve Months ending the 30th of June, 1904.

Tenders to be sent in not later than Thursday, the 25th day of June, 1903.

DAVID JONES,
Secretary.

Ruthin, June 13, 1903.

READING GAS COMPANY.

TAR.

THE Directors of the Reading Gas Company invite TENDERS for the purchase of their Surplus TAR for One Year, commencing on the 1st of July next.

Specifications for the Contract will be forwarded on application.

Railway communication direct to the works.

Tenders, endorsed "Tender for Tar," must be delivered not later than Monday, the 22nd of June, to

ARTHUR H. CANE,
Secretary.

7, King Street, Reading,
June 3, 1903.

ROCHESTER, CHATHAM, AND STROOD GASLIGHT COMPANY.

SUPPLY OF GAS COAL.

THE Directors invite Tenders for the supply of about 45,000 Tons of GAS COAL, to be delivered between the 1st of July, 1903, and the 30th of June, 1904.

Further Particulars, with Form of Contract and Tender, may be had on application, and Sealed Tenders, marked "Coal," are to be delivered to me, at these offices, not later than noon of Tuesday, the 23rd of June, 1903.

J. M. VEEVERS,
Engineer and Secretary.

Gas Offices, Rochester,
June 11, 1903.

BOROUGH OF TORQUAY.

THE Gas-Works Committee of the Torquay Town Council are prepared to receive TENDERS for the supply of 2000 Tons of approved GAS COAL, delivered free into Stores at the St. Mary Church Gas-Works.

Further Particulars and Forms on which Tenders must be submitted may be obtained at my Office, Town Hall, Torquay.

Sealed Tenders, endorsed "Tender for Coal," to be sent to the undersigned not later than Four p.m. on Thursday, June 18, 1903.

The lowest or any Tender will not necessarily be accepted.

(Signed),
FREDK. S. HEX,
Town Clerk.

Town Hall, Torquay,
June 4, 1903.

BOROUGH OF SMETHWICK.

TENDERS FOR GAS COAL.

THE Gas Committee invite Tenders for the supply of about 30,000 Tons of GAS COAL and NUTS for delivery during the Year ending the 30th of June, 1904.

Form of Tender and further Information may be obtained of the undersigned.

Sealed Tenders, endorsed "Tender for Coal," and addressed to the Chairman of the Gas Committee, Town Hall, Smethwick, to be sent in not later than the 26th of June inst.

The Committee do not bind themselves to accept the lowest or any Tender.

By order,
W. J. STURGES,
Secretary.

Gas Offices, Town Hall,
Smethwick, June 13, 1903.

URBAN DISTRICT COUNCIL OF OSWALDTWISTLE.

TENDERS FOR TAR AND LIQUOR.

THE above Council invite Tenders for the TAR and LIQUOR produced at the Gas-Works for One Year from the 1st day of July, 1903.

The estimated quantity of Tar is 280 tons, and that of Liquor 600 tons.

Further Particulars may be obtained on application to the Manager, Mr. T. Loxley, at the Gas-Works, Church, near Accrington.

Sealed Tenders, endorsed "Tender for Tar and Liquor," must be sent to the undersigned on or before Monday, the 29th inst.

No Forms of Tender issued.

B. T. WESTWELL,
Clerk to the Council.

Town Hall, Oswaldtwistle,
June 13, 1903.

THE Haworth Urban District Council are prepared to receive TENDERS for the supply of 2500 Tons of Screened or Unscreened GAS COAL, delivered during the ensuing Twelve Months on rails at Haworth Station.

Sealed Tenders to be sent to me, the undersigned, marked "Tender for Coal," not later than the 2nd of July next.

WILLIAM ROBERTSHAW,
Clerk to the Council.

North Street,
Keighley.

HORNSEY GAS COMPANY.

NOTICE is Hereby Given, that the TRANSFER BOOKS of this Company, relating to DEBENTURE STOCK ONLY, WILL BE CLOSED on the 16th inst., and RE-OPENED on the 1st of July, 1903.

By order of the Board,
WILLIAM E. ROBERTS,
Secretary.

63, Chancery Lane, W.C.,
June 16, 1903.

ISSUES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.

MR. ALFRED RICHARDS begs to notify that his ISSUES by AUCTION under PARLIAMENTARY POWERS of STOCKS and SHARES in LONDON, SUBURBAN, and PROVINCIAL GAS and WATER COMPANIES take place PERIODICALLY at the Mart, TOKENHOUSE YARD, E.C.

Terms for Issuing such Capital, and also for including Gas and Water Stocks and Shares belonging to Private Owners in these Periodical Sales, can be obtained on application at Mr. ALFRED RICHARDS' OFFICES, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the

HARWICH GAS AND COKE COMPANY.

NEW ISSUE OF 500 £5 ADDITIONAL SHARES.

MR. ALFRED RICHARDS will Sell the ABOVE BY AUCTION, at the Mart, E.C., on Monday, July 6, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

TENDRING HUNDRED WATER-WORKS COMPANY.

(Incorporated in 1884), supplying Harwich, Parkeston, and the East Coast Resorts of Dovercourt, Walton-on-Naze, and Frinton-on-Sea, &c.

SALE BY AUCTION OF 500 £10 "A" SHARES.

Ranking up to 8 per cent. Dividend equally with the existing "A" Shares, which have received 4½ per cent. for the last Six Years.

The Water Revenue has risen from £3900 in 1897 to £6638 at the present time; and this new Capital is required for Works necessitated by the increasing demand for Water, the result of the continued development of the district.

MR. ALFRED RICHARDS will Issue the ABOVE BY AUCTION, at the Mart, London, E.C., on Monday, July 6, 1903, at Two o'clock, in Lots, by order of the Directors.

Particulars of Sale, with Form of Instructions for the Auctioneer or Secretary to purchase for Investors unable to attend the Auction, obtainable post free of the SECRETARY of the Company, MISTLEY, ESSEX, or of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By Order of the Directors of the

CROYDON COMMERCIAL GAS AND COKE COMPANY.

SALE OF £2500 FIVE PER CENT. PERPETUAL DEBENTURE STOCK AND £5000 CONSOLIDATED "C" ORDINARY STOCK.

MESSRS. BOOKER and WEBB have received instructions to SELL BY AUCTION, at the Greyhound Hotel, Croydon, on Thursday, the 9th of July, at Six o'clock precisely, in Lots to suit buyers of large or small quantities, £5000 CONSOLIDATED "C" ORDINARY STOCK and £2500 FIVE PER CENT. PERPETUAL DEBENTURE STOCK of the Croydon Commercial Gas and Coke Company. The Dividends paid on the "C" Stock for some years have been at the rate of Nine per Cent. per annum, and since 1898 have been paid free of Income-Tax. The Reserve and Insurance Fund now amounts to £45,056 0s. 9d.

Particulars and Conditions of Sale may be had of the SECRETARY, at the Offices of the Company, Katharine Street, CROYDON; at the place of Sale; and of the AUCTIONEERS, 4, High Street, CROYDON. Telephone, No. 122.

Now Ready, Price 10s. 6d., Green Cloth, Gilt Lettered.

VOL. LXXXI.

OF THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, &c.

Containing the Thirteen Numbers issued during the Three Months, January to March last, together with the Thirteen Plates referring to the New Granton Works of the Edinburgh and Leith Gas Commissioners, and many Photographic Illustrations.

GREEN CLOTH CASES for Binding the Quarterly Volumes of the "JOURNAL," Gilt Lettered, may be had, price 2s.

LONDON:
WALTER KING, 11, Bolt Court, FLEET STREET, E.C.

SOUTH METROPOLITAN GAS COMPANY.

SALE BY TENDER OF £70,000 THREE PER CENT. PERPETUAL DEBENTURE STOCK.

MINIMUM PRICE £90 PER CENT.

NOTICE is Hereby Given, that it is the intention of the Directors of this Company to Sell by Tender £70,000 Three Per Cent. PERPETUAL DEBENTURE STOCK in accordance with the provisions of the South Metropolitan Gas Acts of 1882, 1896, and 1901.

Particulars of same, with Form of Tender, can be obtained at this Office, on application to the undersigned, and Tenders must be sent in on or before Tuesday, the 23rd day of June inst.

The Stock will be allotted to the highest bidders; but no tender will be accepted at a lower price than at the rate of £90 money for each £100 Debenture Stock.

By order,
FRANK BUSH,
Secretary.

Offices: 709, Old Kent Road, London, S.E.,
June 4, 1903.

THE RUGBY GAS COMPANY.

(INCORPORATED BY THE RUGBY GAS ACT, 1882.)

250 SHARES OF £10 EACH (Additional Capital), or such less number as shall be declared at the time of Sale.

TO BE SOLD by Auction, by Mr. JOHN R. TAIT, at the Royal George Hotel, in Rugby, on Friday, the 3rd day of July next, at Four o'clock in the afternoon precisely, by order of the Company (under the provisions of the Rugby Gas Act, 1882),

IN LOTS OF 5 SHARES EACH.

The above Shares are part of the Authorized Additional Capital of the Company, and bear the standard dividend of £7 per cent., subject, under the Sliding-Scale, to increase or diminution with the price charged for Gas.

The present price of gas admits of a dividend on these shares of £10 per cent. per annum.

The dividend on the Original Capital of the Company for the past three years has been £13 per cent. per annum.

Particulars and Conditions of Sale may be obtained, on or after the 10th of June inst., at the Offices of the Company, Railway Terrace, Rugby; of the AUCTIONEER, Albert Street, Rugby; of Messrs. WRATISLAW and THOMPSON, Solicitors, Rugby: or from the undersigned.

T. M. WRATISLAW,
Secretary to the Company.

Rugby.
Dated the 4th day of June, 1903.

NEWCASTLE AND GATESHEAD WATER COMPANY.

SALE OF ORDINARY STOCK.

TO BE SOLD by Auction, in the Board Room of the Company's Offices, Pilgrim Street, Newcastle-on-Tyne, on Tuesday, the 21st of July, 1903, at Half-past Twelve o'clock precisely, by Mr. CHARLES A. JOEL, in such Lots as are provided for in the Company's Act of 1898—

SIXTY THOUSAND POUNDS OF ORDINARY STOCK (ACT, 1898).
(MAXIMUM DIVIDEND £7 PER CENT. PER ANNUM.)

The above Stock is part of the £7 per cent. Maximum Ordinary Stock created under the powers of the Newcastle and Gateshead Water-Works Acts, 1898 and 1902.

The Dividend is subject to proportionate diminution whenever the Maximum Dividend to which each class of Ordinary Stock of the Company is entitled shall not be paid in full, but such diminution may be made up in subsequent Years. The Dividend paid on the Ordinary Stocks of the Company for the past four Years has been as follows:—

On the Original Ordinary £10 per cent. Stock, £8 10s. per cent. per annum.

On the Ordinary £7 per cent. Stock, £5 19s. per cent. per annum.

Printed Particulars and Conditions of Sale may be had at the Company's Offices, and Messrs. GEORGE ARMSTRONG and SONS, Solicitors, Newcastle-on-Tyne; or of the AUCTIONEER, 12, Hood Street, Newcastle-upon-Tyne.

GEORGE SMITH,
Secretary and General Manager.

Newcastle-on-Tyne,
June 9, 1903.

ROBERT MARSHALL,

CANNEL COAL MERCHANT,

97, WELLINGTON STREET, GLASGOW.

Prices and Analysis of all the Scotch Cannels on Application.

THE

PETROLEUM GAS SYNDICATE

Are prepared to erect Installations from 50 to 2000 Lights of their

Petrogene Patent Carburetting Plant

for the Manufacture of **Petroleum Air Gas**, for Gas Companies, Urban Councils, Gas Engineers, &c., on Sale, Hire, or Royalty. **Petroleum Air Gas is equivalent in cost of production to coal gas at about 1s. 6d. per 1000 cubic feet.** It may be used alone or in conjunction with coal gas, and is equally suitable for Lighting, Heating, or Power purposes. No Storage necessary.

For Particulars, apply to

C. E. MASTERMAN, Assoc.M.Inst.C.E.,

28, Victoria Street, Westminster, S.W.

Part 2 Now Ready. *Price* **6d.**

ANALYSES OF BRITISH COALS & COKE

COLLECTED AND COMPARED.

SCOTLAND, WALES, STAFFORDSHIRE, and SOMERSETSHIRE.

(Reprinted from the Colliery Guardian.)

THE COLLIERY GUARDIAN CO., LTD., 49, Essex Street, Strand, London, W.C.

UNEQUALLED.

Gas Companies are solicited to try Samples of the

MIRFIELD

BLACK BED GAS COAL.

Prices and Analysis on application.

MIRFIELD (GAS-COAL) COLLIERY COMPY.

RAVENSTHORPE, NEAR DEWSBURY.

HEATHCOTE GAS COAL.

Rich in Illuminating Power and Yield of Gas.

Above the Average in Weight and Quality of Coke.

Maintains a High Standard in Residuals.

THE GRASSMOOR CO., LD.,

CHESTERFIELD.

THE

"ROTARY"

STATION METER.

Efficiency Demonstrated.

APPLY—

T. G. MARSH,

MAWSON CHAMBERS, DEANSGATE,

MANCHESTER.

JAMES OAKES & CO.,

ALFRETON IRON-WORKS, DERBYSHIRE,

AND

Wenlock Iron Wharf, 21 & 22, Wharf Road, CITY ROAD, LONDON, N.,

Manufacture and keep in Stock at their Works (also large stock in London)

PIPES and CONNECTIONS, 1½ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS, and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with Bolts, Nuts, and Covers, and rendering Leakage impossible.

WELDON MUD

FOR

GAS PURIFICATION,

For use in the

RECOVERY OF SULPHUR,

Also Removal of last Traces of

SULPHURETTED HYDROGEN

in catch position.

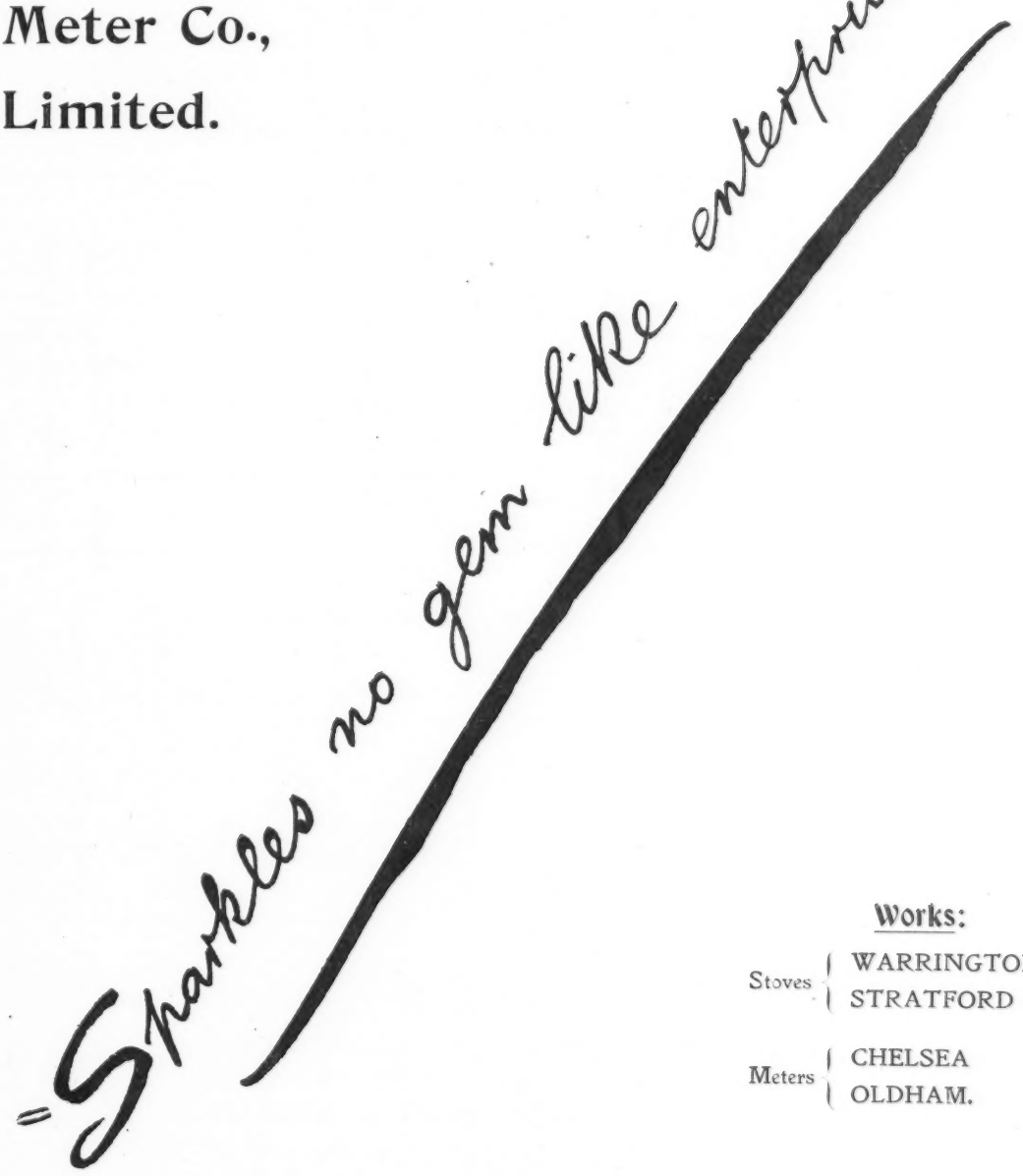
Full Particulars on application to the Patentees

GAS DESULPHURIZATION CO.,

— LIMITED, —

1, FENCHURCH AVENUE, LONDON, E.C.

Richmond Gas Stove and . . . Meter Co., Limited.



Works:

Stoves { WARRINGTON
STRATFORD

Meters { CHELSEA
OLDHAM.

Branches:

LONDON
DUBLIN
PLYMOUTH
BOURNEMOUTH
MANCHESTER
LEEDS.

Stone Gas Light & Coke Company, Limited.

Secretary:
J. J. CHAPMAN.

Stone,
11th May 1903

Gentlemen,

I have very much pleasure in writing you with regard to the results of the recent Exhibition, held in this town by your Company—

The Directors are astonished at the wonderful results that have been effected in so short a time — when we gave you permission to hold an Exhibition, and canvass our consumers we were doubtful as to the results of the undertaking, and we can only speak in the highest manner of the way in which you have carried out the whole of the proceedings, with the remarkable result of upwards of 100 additional Stoves being placed out with our Consumers.

We have had pleasure in sending you an order for both Meters and Cookers, which please execute at your earliest convenience.

Yours faithfully,
John Henderson
Chairman

Messrs The Richmond
Gas Stove and Meter Co Ltd
Stratford E.

Newtown.
N. Wales.
May 25th 1903.

The Richmond Gas Stove and Meter Co. Ld.,
Academy Street,
Warrington.

Gentn.

I regret that your favour of the 13th inst. has not been acknowledged ere this confirming the terms as arranged with your representative, Mr Evans.

I will also take this opportunity of expressing on behalf of the Gas Committee our thanks to you for giving such an excellent Exhibition at Newtown and for rendering us such valuable assistance in the persons of your representative, Mr Evans, your excellent canvasser, Miss Thompson and lady lecturer Miss Laverock with the result that upwards of one hundred stoves have been ordered and I have no doubt we shall be fitting up many more during the next few weeks. I hope to get the Council to write you formally in a few days.

Yours Very Truly
Albert S. Cooke
Chairman of Gas Com.

Richmond's

have a world-wide

Reputation.

Printed for WALTER KING by King, Sell, & Olding, Ltd., and Published by him at 11, Bolt Court, Fleet Street, in the City of London.—Tuesday, June 16, 1903.

TROTTER, HAINES, & CORBETT, LIMITED,
Brettell's Estate
FIRE-CLAY & BRICK WORKS,
STOURBRIDGE.

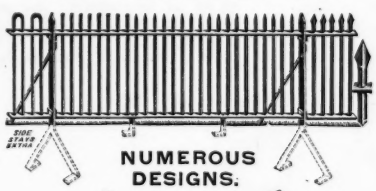
Manufacturers of GAS-RETORTS GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.
Special Lumps, Tiles, and Bricks for Regenerative and Furnace Work.
SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.

LONDON OFFICE: R. CULL, 34, OLD BROAD STREET, E.C.

THOMAS DUXBURY & CO.,
16, DEANSGATE, MANCHESTER.
Best Gas Coal and Cannel, giving High Illuminating Power, Large Yield per ton, and reasonable in Price.
Telegrams: "DARWINIAN, MANCHESTER."
Telephone 1806.

NEWBATTLE CANNEL.
Highest Results in Gas, & Excellent Coke.
QUOTATIONS ON APPLICATION TO
THE LOTHIAN COAL COMPANY,
LIMITED,
NEWBATTLE COLLIERIES,
DALKEITH, N.B.

BAYLISS,
JONES,
AND
BAYLISS
LIMITED,
Manufacturers of
IRON RAILING &c.



NUMEROUS DESIGNS.

COKE-BARROWS.

LISTS FREE.
BAYLISS, JONES & BAYLISS.
WOLVERHAMPTON,
And 139 & 141, Cannon St., London, E.C.

PRICE'S COKE & COAL BARROW

effects a great saving of time, labour, and expense.

For Particulars Price, &c., apply to Mr. EDWARD PRICE, "Langley," Wyke Avenue, WORTHING.

High Grade Gas-Cookers at Bottom Prices.

We are securing large orders.
Compare our Prices with other Makers'.

ALL IMPERIAL STOVES GUARANTEED.
ORDERS PROMPTLY DESPATCHED.

THE IMPERIAL STOVE COMPY.
LEAMINGTON SPA.
Telegrams: "Imperial, Leamington."
Telephone: One X.

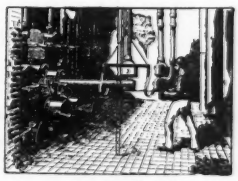
THE SILICA FIRE-BRICK COMPANY,
OUGHTIBRIDGE, near SHEFFIELD.
MANUFACTURE
SILICA BLOCKS, BRICKS, AND CEMENT
OF SUPERIOR QUALITY
FOR GAS-FURNACES.
Trade Mark: "SILICA."
These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their
GREATER DURABILITY,
Strongly recommended where EXCESSIVE HEATS have to be maintained.

THOMAS TURTON AND SONS, LIMITED,
SHEAF WORKS, SHEFFIELD,
MANUFACTURERS OF
FILES OF BEST QUALITY
FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
SCREW STOCKS, TAPS AND DIES, SPANNERS, RATCHET BRACES, LIFTING JACKS, ANVILS, VICES, AND ENGINEERS' TOOLS GENERALLY.
LONDON OFFICE:
90, CANNON STREET, E.C.

COKE-BREAKERS,
PRICES REDUCED.
(THOMAS & SOMERVILLE'S PATENT)
With Elevators and Conveyors worked by Steam or Gas Engine.
GEORGE WALLER & SON,
165, QUEEN VICTORIA STREET, E.C.;
And at STROUD, GLOUCESTERSHIRE.

ATTERTON'S
CHARGING APPARATUS

Nearly **40** of these Machines have been



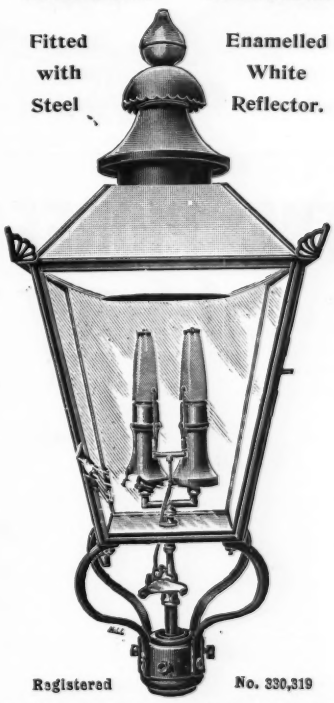
supplied to English Gas-Works.

Sole Agents for the United Kingdom:
E. PADFIELD & CO.,
96 & 98, LEADENHALL STREET, E.C.
Representatives:
Messrs. BELL & CO., Engineers, CARDIFF,
Mr. J. B. MACDERMOTT, GLASGOW, and
J. BYRON MACKENNA, DUBLIN

THE
"KILBURN" LANTERN.

Fitted with Steel

Enamelled White Reflector.



Registered No. 330,319

The "Kilburn" Lantern (for double lights) and the "St. Albans" Lantern have been adopted for lighting the Town of St. Helens.

H. GREENE & SONS, Limited,
Surrey Engineering Works,
Blackfriars Road, LONDON.
Telephone 1693 HOP.
Telegrams: "LUMINOSITY LONDON."

Wrought-Iron TUBES

And Fittings & Accessories.

LAMBERT BROS., WALSALL,
MANUFACTURERS OF
WROUGHT-IRON TUBES & FITTINGS for GAS, WATER, & STEAM.
BRASS GAS-FITTINGS, GAS-VALVES, STEAM & WATER VALVES, TOOLS, &c., AND OF WARNER'S PATENT MARKET GAS STAND-PIPE.
LONDON: LAMBETH BRASS & IRON CO., LTD., 91 & 93, SOUTHWARK ST., S.E.

JOHN WALSH & SONS,

CARBONIZING ENGINEERS & CONTRACTORS,

TELEGRAMS:
"RETORT HALIFAX."

36, GERRARD ST., **HALIFAX.**

ESTIMATES AND DRAWINGS ON APPLICATION.

INSTALLATIONS OF INCLINED OR HORIZONTAL RETORTS ERECTED COMPLETE.
RETORT-BENCHES, WITH GENERATOR AND REGENERATOR FURNACES, SHALLOW OR FULL.
DIRECT-FIRED SETTINGS ERECTED TO SUIT ANY GAS-WORKS.

GAS
THE WINSTANLEY SPECIALTY COY.
ENGINEERS

GAS ENGINEERS.

CONTRACTORS FOR, AND ERECTORS OF, ALL GAS-WORKS PLANT.

REGENERATORS, GENERATORS, AND DIRECT-FIRED RETORTS.

RESULTS GUARANTEED.

COMPLETE INSTALLATIONS OF HORIZONTAL AND INCLINED RETORTS.

ADDRESS—

NEWTON CHAMBERS, CANNON ST., **BIRMINGHAM.**

THE PIONEER RAMIE THREAD MANTLES

"VERITAS"

Have proved the most successful for Street Lighting and Maintenance.

AVERAGE LIGHT 95 CANDLES.
KEEP THEIR SHAPE.
WILL STAND ROUGH HANDLING.
LAST LONGEST.

Special Quotations for Large Quantities.

MANTLES for every size BURNER kept in Stock.

Write for our Special List of MANTLES, BURNERS, and SUNDRIES.

FALK, STADELMANN, & CO., LD.

"VERITAS" LAMP WORKS,

83, 85, & 87, FARRINGDON ROAD, LONDON, E.C.

GIBBONS BROS.

(LIMITED),

Telegraphic Address: "GIBBONS, LOWER GORNAL." **DUDLEY,** *Telephone No.* 10a, DUDLEY EXCHANGE.

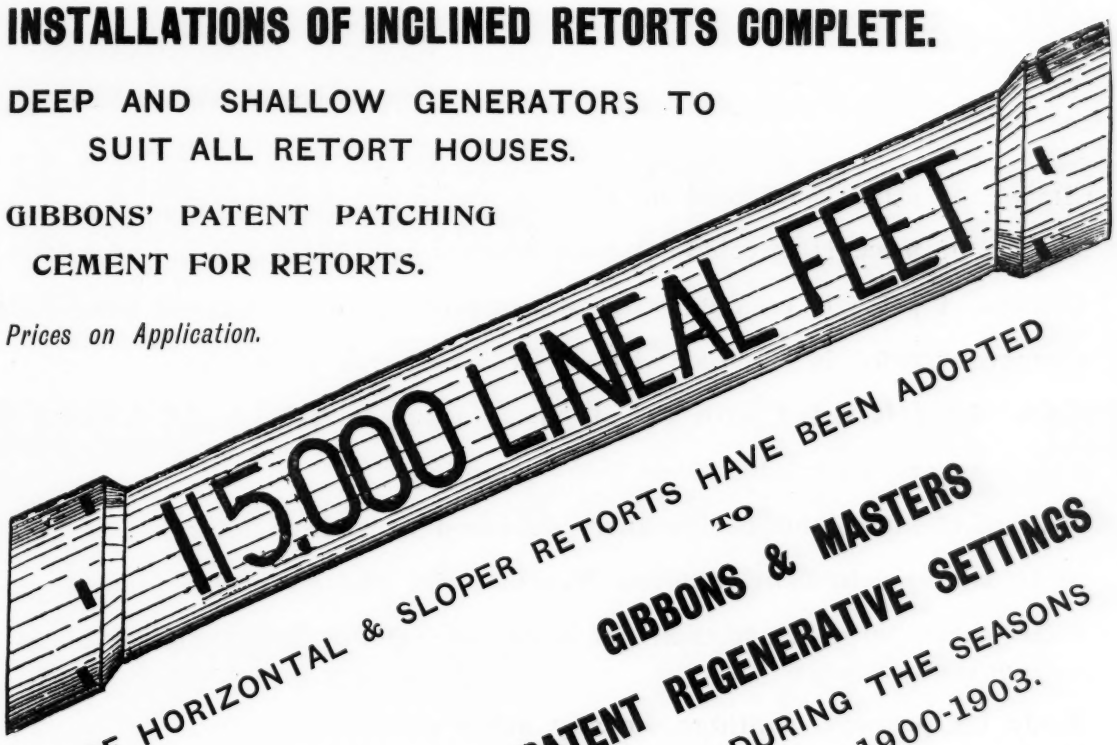
Erectors of Retort Benches, with Generator and Regenerator Settings, and Retort-Bench Ironwork Complete.

INSTALLATIONS OF INCLINED RETORTS COMPLETE.

DEEP AND SHALLOW GENERATORS TO SUIT ALL RETORT HOUSES.

GIBBONS' PATENT PATCHING CEMENT FOR RETORTS.

Prices on Application.



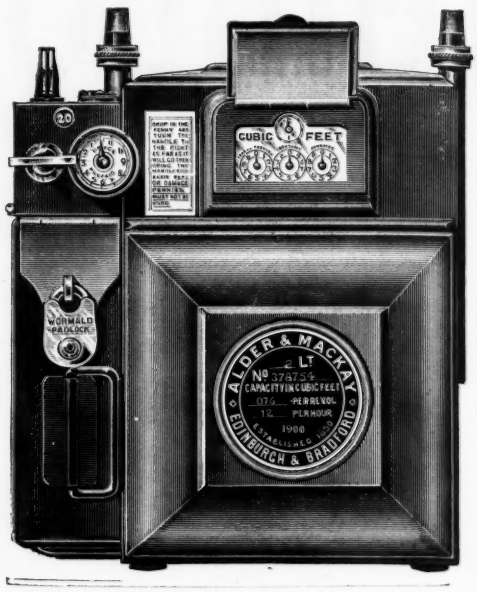
NOTE—Buckstaves, Tie-Rods, and General Retort-Bench Ironwork from Stock.

We now Manufacture our own Elevating and Conveying Machinery.

MOUTHPIECES	FURNACE	GIRDERS
RETORT LIDS	FITTINGS	FLOOR PLATES
HYDRAULIC MAINS	AND	VALVES
CONDENSERS	RETORT	CHARGING SHOOTS
SCRUBBERS	MOUNTINGS	FOR PRODUCERS
PURIFIERS		ROOFS

A Few of the Points to be Found

in this ☛



1. Change of price is effected by the alteration of ONE wheel only.
2. Change of price is effected without disconnecting the meter.
3. Change of price is effected without removing Coin Mechanism from Meter.
4. Change of price is effected without unlocking the Cash Box.
5. Each Meter is fitted with Patent slot-closing device.
6. This ensures no trouble from coins jamming.
7. Coin mechanism can be instantly detached from the Meter.
8. With coin mechanism removed Meter works like an ordinary one.
9. Fitted with large Cash Box, yet occupying almost the same space as an ordinary meter.
10. Made for pennies, shillings, or any other coin.

SAMPLES AND PRICES TO BE OBTAINED FROM

ALDER & MACKAY,

New Grange Works,
EDINBURGH.
Telegrams: "Alder, Edinburgh."
Telephone 1481 Central.

Ventnor Street Works,
BRADFORD.
Telegrams: "Alder, Bradford."
Telephone: 1222.

13, Victoria St., Westminster,
LONDON.
Telegrams: "Alderugi, London."

SILICA FIRE-BRICK Co.

OUGHTIBRIDGE,

Nr. SHEFFIELD.

ESTABLISHED 1858. Trade Mark: "SILICA."

SILICA BLOCKS, BRICKS, AND CEMENT

OF SUPERIOR QUALITY FOR GAS FURNACES.

GANISTER BRICKS

SHOWING LITTLE OR NO SHRINKAGE.

"HOLDSOWN" CEMENT

FOR PATCHING RETORTS AND FURNACES TO WITHSTAND THE HIGHEST HEATS.

These goods, on account of their **GREATER DURABILITY**, are used by the largest Gas-Works in the World.

Great Reduction in the Cost of Purifiers

LUTELESS PURIFIERS

WORKED WITHOUT ANY CONNECTIONS AT ALL

(RAMSDEN & SMITH'S PATENT, No. 12,034.)

No complicated arrangement of Valves, each requiring separate manipulation.

No Internal Pipes interfering with Purifying Area.

Every part easily accessible.

FOR PRICES AND ALL PARTICULARS, APPLY TO THE MAKERS:

EDWARD COCKEY & SONS, LD.

Engineers and Contractors for Gas Plant of every Description,

FROME, SOMERSET.

Telegrams: "COCKEYS, FROME." — Telephone No. 16 FROME. — Telegrams "DAMPER, LONDON."

London Office: BRIDGE HOUSE, 181, QUEEN VICTORIA STREET, E.C. Messrs. BALE & HARDY, Agents.

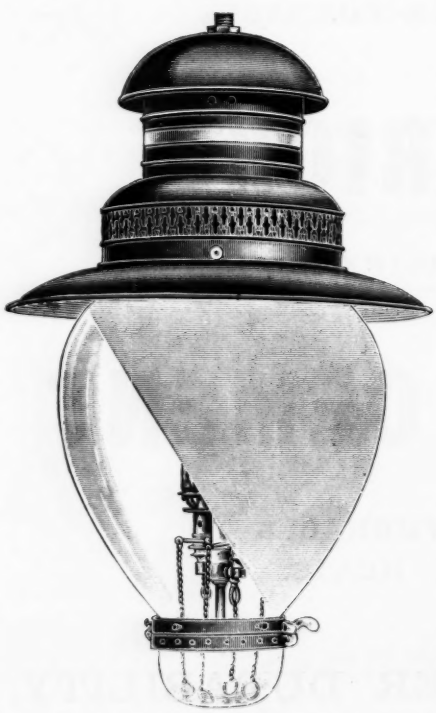
J. & W. B. SMITH,

19, 21, & 23, Farringdon Rd., LONDON, E.C.

FOR

SMALL BRASS * * *

* * * GAS FITTINGS.



2-light ALBANY LAMP
for "C" or Kern Burners.

NEW PRICE LIST ON APPLICATION.

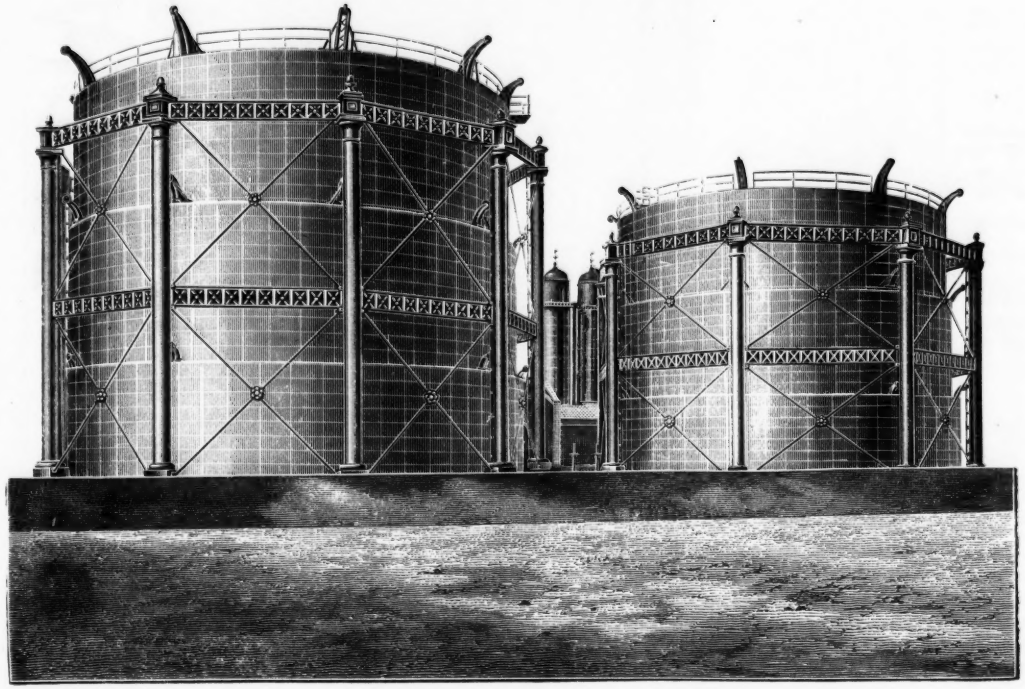
GENERAL GAS FITTINGS AND GLASS
OF EVERY DESCRIPTION.

ARC LAMPS A SPECIALITY.

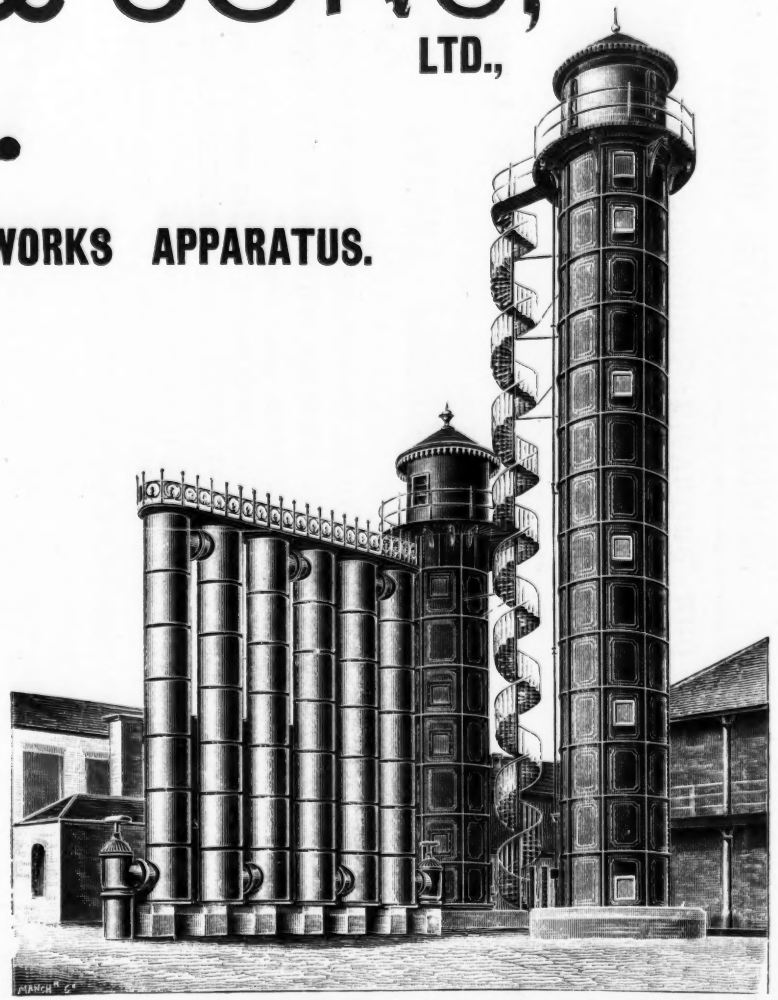
GLASMI Mantles are the BEST.

R. DEMPSTER & SONS, LTD.,
ELLAND.

MANUFACTURERS OF EVERY DESCRIPTION OF GAS-WORKS APPARATUS.



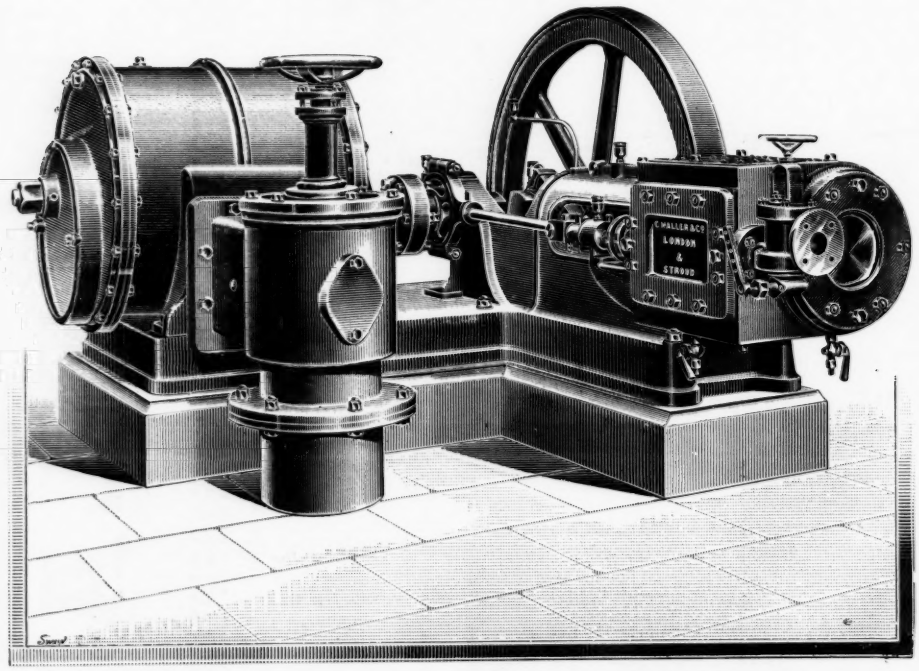
Gasholders.
With Inner Lifts rising above Guide Framing.



Annular Condensers.
Tower Scrubbers.

GEO. WALLER & SON,

165, QUEEN VICTORIA STREET, LONDON, E.C.



PATENT EXHAUSTER AND COMBINED ENGINE (30,000 to 80,000 Type). Also made with Slipper Guide.

MANUFACTURERS OF

IMPROVED EXHAUSTING MACHINERY

OF ALL CAPACITIES AND FOR ALL PURPOSES FROM 500 TO 500,000 CUBIC FEET PER HOUR.

WALLER'S PATENT 3 & 4 BLADE EXHAUSTERS

Use LESS STEAM, and give a STEADIER GAUGE than any other type.

Nearly 1000 in use.

Recent Orders for Glasgow (8 Sets), South Metropolitan Gas Company, Sheffield, Manchester, Bradford, Leeds, Chester, Dundee, &c., &c., &c.

BEALE'S EXHAUSTERS CONVERTED TO OUR PATENT 3 AND 4 BLADE SYSTEM
to increase their capacity from 30 to 45 per cent. when running at the *same speed,* and giving a *steadier gauge.*

PATENT COMBINED SETS OF EXHAUSTERS AND ENGINE (STEAM OR GAS), FOR 500 TO 15,000 CUBIC FEET PER HOUR (WITH DISC VALVES, BYE-PASS GOVERNOR, AND THROTTLE VALVE, ALL ON ONE BASE PLATE.

ALSO MAKERS OF

PATENT PHŒNIX WASHER-SCRUBBERS,

With WOOD CLUSTERS, Simple, Efficient, and Durable.

PATENT STEAM REGULATORS FOR EXHAUSTERS.

Absolutely automatic in their action, and insure level gauge.

GAS VALVES OF ALL DESCRIPTIONS TO 48-inches.

PHŒNIX STEAM TAR AND LIQUOR PUMP.

Certain Action, Large Capacity, Slow Speed.

Coke Breaking, Screening, Elevating, and Conveying Machinery.

WORKS: STROUD, GLOUCESTERSHIRE. Telegrams: { London—"WEIGHBEAM, LONDON." Stroud—"WALLER, BRIMSCOMBE."

PARKINSON'S

STATION METERS.

ALL SIZES

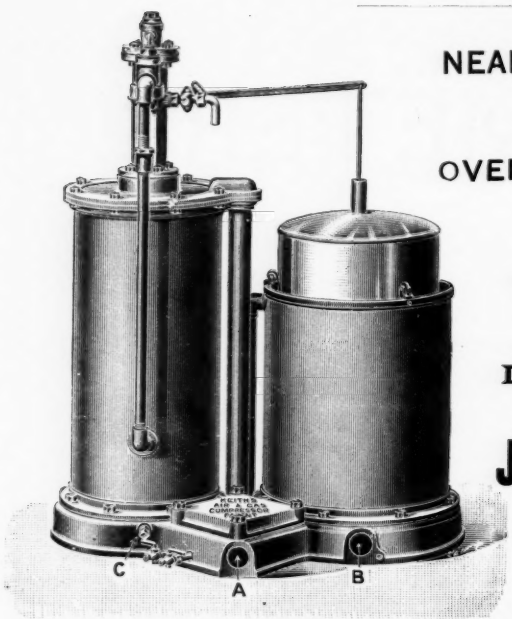
UP TO 300,000 PER HOUR.

PARKINSON AND W. & B. COWAN, LTD.
(*Parkinson Branch*),
COTTAGE LANE, CITY ROAD, LONDON.
BELL BARN ROAD, BIRMINGHAM.

THE

KEITH LIGHT

(Intensified Incandescent Gas.)



NEARLY **1000** INSTALLATIONS

already in use, with lighting capacity

OVER **6,000,000**—CANDLE POWER.

SEND FOR ILLUSTRATED PAMPHLETS ON

THE KEITH LIGHT

FOR

DISTRIBUTION TO LARGE CONSUMERS.

JAMES KEITH & BLACKMAN CO.,

LIMITED

27, Farringdon Avenue, LONDON, E.C.

AND MANCHESTER, GLASGOW, LEEDS, BIRMINGHAM,
BRISTOL, and BELFAST.

THE GAS COAL COLLIERIES, LIMITED,

OWNERS OF

MEIROS COLLIERY,

Glamorganshire, South Wales,

Producing the **BEST GAS COAL** of the District,

On G.W.R. Main Line.

SHIPPING PORTS—Cardiff, Barry, Newport, Port Talbot, and Swansea. *DOCKS OFFICE—1, Stuart Street, Cardiff.*

REGISTERED OFFICES—29, St. Mary Street, CARDIFF.

HANNA, DONALD, & WILSON,

(Established 1851),

GAS ENGINEERS & CONTRACTORS,

ABERCORN FOUNDRY AND ABBEY WORKS,

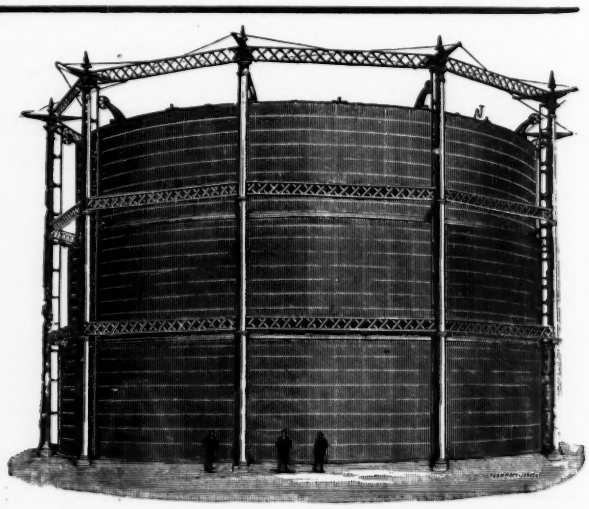
PAISLEY, N.B.,

MAKERS OF

Gasholders & Gas Plant

OF EVERY DESCRIPTION.

Telegraphic Address: "Donald, Paisley."



To Gas Engineers and Managers.

Your enquiries and orders for **Purifiers and Centre Valves, Condensers, Scrubbers, Ammonia Stills and Saturators, Tanks, Washers, Retort Ironwork, Special Castings, Valves, &c., and Gasholders,** are particularly requested.

We are in a **special position** for carrying out work in connection with the above in a **cheap** and **expeditious manner.**

We have recently made large **additions** to our **Works** in the way of **New Foundry, Fitting Shops, and Constructional Sheds,** and have **equipped** these **departments** with the most **recent** and **modern machinery and labour-saving appliances.**

All our work can be done under cover, and we are able to deal with a much larger volume of orders than hitherto, and to turn out **first-class work** at **lowest prices** and in the **shortest possible time.**

Any enquiries or orders entrusted to us will receive our most careful attention, and we ask you to bear the name of

ASHMORE, BENSON, PEASE, & CO., LTD.,

STOCKTON-ON-TEES,

in mind when you are contemplating any new work or additions.

Telegrams: "GASHOLDER."

WILSON CARTER & PEARSON LIMITED,

GAS COAL AND CANNEL FACTORS,

Supply to any Railway Station, or for Export, all kinds of Fuel for Gas and Other Purposes.

ADDRESS CHIEF OFFICES:

Temple Buildings, 50, New Street, Birmingham.

THE EXPORT MANTLE

SUPPLIED TO 180 GAS COMPANIES.

Illuminating Power 80 to 700 Candles.

EXPORT MANTLES, 27/- PER GROSS.
EXPORT REMA SILK MANTLES.
EXPORT HIGH-PRESSURE MANTLES.

Special Quotation for Large Quantities.

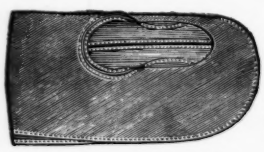
MANTLES MADE to COMPANY'S own PRESCRIPTION.

Special low Quotations with their own Labels and Stamps.
Burners of all description, solid Brass, from **1/9** per dozen.

NEW EXPORT INCANDESCENT LIGHTING CO., LTD.,
36, MANSELL STREET, LONDON, E.C.
Telephone No. 4916 Central.
Telegraphic Address: "Export Mansell Street, London."

THOMAS BUGDEN, MANUFACTURER OF

TAR and LIQUOR HOSE. and Special AIR TUBING.



BELLOWS made to inflate a 48-inch Bag under One Minute. Various sizes made.

STOKERS' MITTS.
Made from best Tanned Leather.

India-rubber Goods of every description. Leather Bands Oils, &c., Diving and Wading Dresses, Waterproof, Coat Capes, Sewer Boots, and Theatrical Dresses.

Fire-Engine Hose and Appliances.

Best Materials and Workmanship Guaranteed.

Miners' Woollen Jackets No. 1, 12/- each; No. 2, 9/6.

Gas-Bags for Mains. All Seams stitched.

71, GOSWELL ROAD, E.C.

HARPER & MOORES, Limited,

STOURBRIDGE.

MANUFACTURERS OF

Inclined, Horizontal, and Segmental

GAS-RETORTS,

Fire-Bricks, Fire-Clay Lumps, and Tiles

OF EVERY DESCRIPTION.

Also Manufacturers of **Cast-Iron Retorts, Iron Mouthpieces, Pipes, and all necessaries for Gas-Works requirements.**

Telegraphic Address: "MOORES, LYE. Telephone No. 23 Lye.

MACKRELL BROS.,

Buslingthorpe Lane, LEEDS,

Manufacturers of

IMPROVED GAS-METER PERSIANS,

UNSURPASSED FOR QUALITY AND VALUE.

JOSEPH CLIFF & SONS

(BRANCH OF THE LEEDS FIRE-CLAY CO., LTD.),

WORTLEY, LEEDS.

Cliff's Wortley Silica Bricks.

FOR Arches and Crowns where high heats are required. They contain over 90 per cent. of Silica, and are nearly stationary under the influence of heat, swelling a little rather than contracting. They are not like a Gannister or Dinas Brick, but a Fire-Brick of a highly Silicious nature.

Cliff's Wortley Aluminous Bricks.

THESE are for Side Walls where great wear and tear takes place. Are made of a specially prepared mixture, are high in Alumina, and are what is termed a HARD FIRE-BRICK.

BALTIC WHARF, WATERLOO BRIDGE, LONDON, S.E.
Liverpool: Leeds Street. Leeds: Queen Street.

GIBBONS BROS., LTD.,

Tel. Address: "GIBBONS LOWER GORNAL." **DUDLEY.** Telephone No. 10A, DUDLEY EXCHANGE.

Gas Engineers, Contractors, Retort Setters.

INSTALLATIONS OF INCLINED RETORTS COMPLETE.

ELEVATORS AND CONVEYORS A SPECIALITY

Installation of 10 Settings of 8 Inclined Retorts recently erected by us.

PATENT REGENERATIVE SETTINGS

GIBBONS' & MASTERS' PATENT No. 1269, 1893.

SUITABLE FOR WORKS OF EVERY CAPACITY.

And a special Form of which is applicable to

GASEOUS FIRING WITH A MINIMUM EXCAVATION.

RETORT BENCH IRONWORK CONDENSERS,	*SCRUBBERS, PURIFIERS, VALVES, ROOFS,*	*GIRDERS AND STRUCTURAL IRONWORK.*

DESIGNS AND ESTIMATES ON APPLICATION.

THE WIGAN COAL & IRON CO., LIMTD.,

Are exclusive Owners of the well-known HAIGH HALL & KIRKLESS HALL GAS COAL COLLIERIES, and supply the Best Wigan Arley Mine Gas Coal, Gas Nuts, Gas Cannel, Cannel Nuts, &c.

MIDLAND AND WEST OF ENGLAND DISTRICT OFFICE: *6, CORPORATION STREET, BIRMINGHAM—Sole Agent: A. C. SCRIVENER.*
Telegraphic Address: "WIGAN, BIRMINGHAM." Telephone No. 200.

LONDON DISTRICT OFFICE: *6, STRAND, LONDON—C. PARKER & SON, Sole Agents.*
Telegraphic Address: "PARKER, LONDON."

BOWENS' Ltd. Successors,
STOURBRIDGE.

MANUFACTURERS OF
BEST FIRE-BRICKS; INCLINED, HORIZONTAL, and SECTIONAL RETORTS; LUMPS, TILES, &c., of every description.
ESTABLISHED 1860.

CLAYTON SON & Co LTD LEEDS
MAKERS OF THE LARGEST GASHOLDER IN THE WORLD ALSO
THE ORIGINAL MAKERS OF
SPIRAL GUIDED GASHOLDERS
MAKERS OF ALL KINDS OF
STRUCTURAL IRON & STEEL WORK. STEEL FRAMED BUILDINGS
ROOFS RETORT FITTINGS
PURIFIERS RETORT LIDS
ANTIFREEZERS for Gasholders
STEEL TANKS
OF ALL SIZES
MAKERS OF THE LARGEST IN THE WORLD.
GASHOLDERS
OF EVERY DESCRIPTION & SIZE
HIGH CLASS BOILERS FITTED WITH DEIGHTON'S PATENT CORRUGATED FLUES.
Telegrams "GAS LEEDS." London Office 60 Queen Victoria St E.C.

MANNESMANN

LAMP POSTS
made throughout of
WELDLESS STEEL TUBING
including base, ring, and ladder rest.

Light, Strong, Unbreakable, and Cheap.

GAS, WATER, & STEAM TUBES AND FITTINGS.

WELDLESS STEEL SPIGOT & FAUCET PIPES
for Gas and Water Mains.

Tubes can be supplied up to 10 inches diameter and in lengths up to 30 feet.

THE BRITISH MANNESMANN TUBE COMPANY, LTD.,
Landore, South Wales.
Birmingham Depôt: 110, COLMORE ROW.
London Office: 110, CANNON STREET, E.C.

R. & J. DEMPSTER, LD., MANCHESTER.
Telegraphic Address: "SCRUBBER, MANCHESTER."
National Telephone: Nos. 54 and 2296.

IMPROVED Water-Cooled Condensers

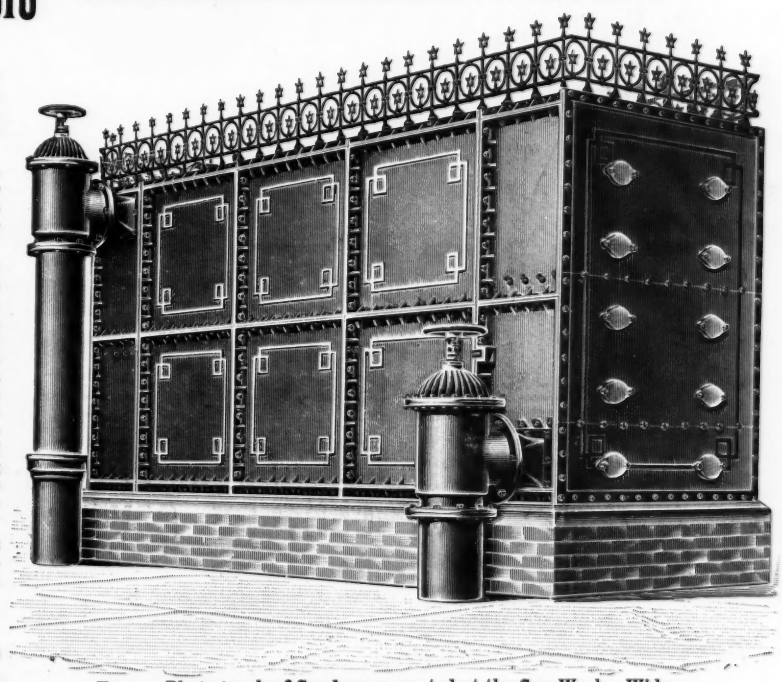
This water-cooled Gas Condenser is designed to work against the great variations of temperature between day and night, sunshine and shade, summer and winter, which are found in this and other countries.

Water being the cooling medium, the temperature of the gas can be kept under control better than with air; and the gas can be sent forward to the purifying plant at the proper temperature for efficient and economical purification.

The cold water enters at the bottom, and gradually rises to the top as the water absorbs heat, thus causing the warm gas to meet the warm water first, and to leave the Condenser in contact with water at any desired temperature by simply regulating the feed-water tap. The gas is thus **cooled progressively, uniformly, and effectually.** The simple construction of this Condenser affords a large cubical capacity, so that the gas remains in a considerable time, and secures all the advantage due to slow-speed condensation. Every part of the Condenser is easily accessible, and by removing the end plates the whole of the interior can be got at. It can be erected under cover, and protected from extremes of heat or cold.

R. & J. DEMPSTER, LTD., recommend this Condenser to be used as a Finishing Condenser, after the gas has already passed through the ordinary Annular or Air Condensers.

Condensers of this type equal to 10,500,000 cubic feet per 24 hours already erected and at work.



From a Photograph of Condenser erected at the Gas-Works, Widnes.
Capacity 1,500,000 cubic feet per 24 hours.

ONLY?

THE "DE BROUWER" PATENT HOT COKE CONVEYOR

IS THE

ONLY COKE CONVEYOR of which 14 installations are working in England.

IT IS THE

ONLY COKE CONVEYOR of which every installation erected is working and continues to work without rebuilding.

IT IS THE

ONLY COKE CONVEYOR which serves as an ideal for competing manufacturers to copy and crib in principle and detail.

IT IS THE

ONLY COKE CONVEYOR which has 7800 feet working daily in England alone.

IT IS THE

ONLY COKE CONVEYOR which gives no trouble from breakdown at starting and in depth of winter.

IT IS THE

ONLY COKE CONVEYOR which relieves the Manager's mind at times of urgency.

IT IS THE

ONLY COKE CONVEYOR which saves labour largely.

BECAUSE

It is original in design—no slavish copy or colourable imitation of a better thing—its details are based on large experience.

It is well designed, strongly constructed, of excellent material.

CONSEQUENTLY

IT WORKS WELL.

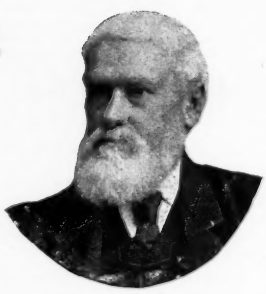
SOLE MANUFACTURERS—

W. J. JENKINS & CO., LTD., RETFORD.

CLAPHAM BROTHERS

ESTABLISHED 1837.

LIMITED.



OUR SPECIALITIES ARE IN GREAT FAVOUR.

"ECLIPSE"

WASHER SCRUBBER (Laycock and Clapham's Patent).

WATER TUBE CONDENSER (Clapham's Patent).

RAPID AUTOMATIC FASTENINGS AND **RUBBER JOINT** (Clapham's Patent) FOR

DRY LUTE PURIFIERS.

THE **"NEW CENTURY COVER"** FOR **PURIFIERS.**

SELF-SEALING MOUTHPIECES for Inclined and Horizontal Retorts. **MAINS, VALVES, &c.**

LONDON AGENT:—THOMAS B. YOUNGER, C.E., Chesterfield House, 98, Great Tower Street.

WELLINGTON, NELSON, and MARKET STREET WORKS, KEIGHLEY.

Printed for WALTER KING by King, Sell, & Olding, Ltd.; and published by him at 11, BOLT COURT, FLEET STREET, in the CITY OF LONDON.—Tuesday, June 16, 1903.